federal register

Thursday
July 19, 1979

Part II

Department of Transportation

Federal Aviation Administration

Noise Standards for Helicopters in the Normal, Transport, and Restricted Categories

Federal Aviation Administration

[14 CFR Parts 21 and 36]

[Docket No. 13410; Notice No. 79-13]

Noise Standards for Helicopters in the Normal, Transport, and Restricted Categories

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rule making.

SUMMARY: This notice proposes regulations growing out of FAA's review of preliminary proposals for regulating noise of civil "short-haul," including rotary wing, aircraft contained in an advance notice of proposed rule making and is based on review of recent tests and studies of helicopter noise characteristics. These proposals apply to civil helicopters certificated in the normal, transport, and restricted categories. For purposes of this notice, "helicopters" include other aircraft for which lift is furnished, in whole or part, by an engine-driven rotor during takeoff, hover, or landing. The proposals provide noise levels and test procedures for the issuance of new type certificates and of original standard airworthiness certificates and restricted category airworthiness certificates for newly produced helicopters of older design types. They also include a prohibition of certain changes in the type design of helicopters that might increase their noise levels beyond prescribed limits. The FAA believes that the rules are necessary to provide current and future relief and protection to the public health and welfare from the noise of the affected helicopters, but that it should not propose rule making at this time for the other aircraft covered by the advance notice.

DATES: Comments must be received on or before: November 19, 1979.

ADDRESSES: Send comments on the proposal in duplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attn: Rules Docket (AGC-24), Docket No. 13410, 800 Independence Avenue, SW., Washington, D.C. 20591.

FOR FURTHER INFORMATION CONTACT: Richard Tedrick, Noise Policy and Regulations Branch (AEE-110), Noise Abatement Division, Office of Environment and Energy, Federal Aviation Administration, 800 Independence Avenue, Washington, D.C. 20591; telephone (202) 755-9027.

SUPPLEMENTARY INFORMATION:

I. Comments Invited

Interested persons are invited to participate in the making of the proposed rule by submitting such written data, views, or arguments as they may desire. Comments are specifically invited on the overall regulatory, economic, and environmental aspects of the proposed rule, including environmental impacts other than noise. Communications should identify the regulatory docket or notice number and be submitted in duplicate to the address listed above. All communications received on or before the specified closing date for comments will be considered by the Administrator before taking action on the proposed rule. The proposals contained in this notice may be changed in the light of comments received. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerned with this rule making will be filed in the docket.

II. Availability of NPRM's

Any person may obtain a copy of this notice of proposed rule making (NPRM) by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Information Center (APA-430), 800 Independence Avenue, SW., Washington, D.C. 20591, or by calling (202) 426-8058. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future NPRMs should also request a copy of Advisory Circular No. 11-2 which describes the application procedure.

III. Synopsis of Proposals

The FAA is considering amendments to Parts 21 and 36 of the Federal Aviation Regulations (FARs) to prescribe noise levels and test procedures for civil helicopters certificated in the normal, transport, and restricted categories. As used throughout this notice, the word "helicopter" means rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotor and other aircraft for which lift is furnished, in whole or part, by an engine-driven rotor during takeoff, hover, or landing; however, it does not include gyroplanes. These proposals include rules governing the issuance (1) new type certificates for helicopters for which application is made on and after the publication date of this notice, and (2) original, standard airworthiness certificates and restricted category airworthiness certificates for helicopters which do not have any flight time before January 1, 1985 (regardless of the date of application). The proposed rule would prohibit certain growth or other design changes if those changes might result in noise levels beyond prescribed limits. Those "acounstical change" provisions would apply to approvals applied for on or after the effective date of the final rule based on this proposal. The proposed rule also provides the test conditions and procedures for conducting helicopter noise tests to demonstrate compliance with the prescribed noise levels, including the technical noise measurement and evaluation specifications employing the concept of Effective Perceived Noise Level (EPNL) as the evaluation unit.

The proposed helicopter noise standards, if adopted, would have the following effects:

A. Certification Procedure Provisions

FAR Part 21 would be amended to prescribe the procedural requirements for noise certification of civil helicopters certificated in the normal, transport, and restricted categories. Those proposed amendments apply to the issuance of new type certificates in the normal, transport, or restricted categories for which application is made on or after the publication date of this notice and to the original issuance of standard airworthiness certificates and restricted category airworthiness certificates for newly produced helicopters which do not have flight time before January 1, 1985 (regardless of the date of application). The effect of these provisions would be to prohibit issuance of the affected certificates after the effective date of the amendments for helicopters which have not been shown to comply with the applicable noise requirements of Part 36. Thus, newly type certificated helicopters (except those for which application was made before publication of this notice) and eventually all newly produced helicopters of older type designs (those aircraft without flight time before 1985) would be required to comply with Part 36 noise standards. Further, proposed "acoustical change" provisions would prescribe requirements for certain changes in type design of helicopters which might increase their noise levels. Appropriate references to Part 36 acoustical change requirements would be contained in Part 21. The proposed acoustical changes for helicopters would specifically apply to type design

changes that involve (1) changes to, or removal of, mufflers or other components designed for noise control; (2) any change that results in an increase in certificated maximum rotor RPM, maximum continuous power, takeoff power, or maximum takeoff weight; and (3) any other design change that the Administrator determines might increase noise levels of that helicopter, such as changes in rotor size, number of blades, or blade shape. Under the proposal, noise test procedures, conditions, and noise limits for acoustical changes would be prescribed under Part 36.

B. Noise Standard Provisions

FAR Part 36 would be amended to adopt the provisions necessary to prescribe noise standards for civil helicopters certificated in the normal, transport, and restricted categories. Those provisions are similar to those currently applicable to many other aircraft under Part 36 and are summarized as follows:

1. *General.*—The general provisions of Part 36, Subpart A, would be amended to provide applicability, definitional, and acoustical change provisions covering civil helicopter noise certification. For example, the word "aircraft" is substituted for "airplane" in those provisions whose applicability simply would be expanded to include helicopters. Under the proposal, definitions identify two "stages" or levels of noise ("Stage 1" and "Stage 2" helicopter noise levels) and which helicopters have been shown to comply with the proposed Stage 2 noise levels ("Stage 2 helicopters"). "Stage 1 helicopters" are those which have not been shown to so comply.

A new section would be added to prescribe noise requirements for those changes in type design defined as "acoustical changes" under FAR Part 21. Those provisions would apply to acoustical change approvals applied for on and after the effective date of the rule. Specifically, Stage 1 helicopters before a change in type design would be prohibited from increasing any noise level (takeoff, flyover, or approach) after the design change. For acoustical changes of Stage 1 helicopters, the proposed tradeoff provisions could not be used to increase any Stage 1 noise level. A Stage 2 helicopter before a change in type design could not be Stage 1 helicopter after the design change.

2. *Manuals, Markings, and Placards.*—Provisions regarding requirements for operating limitations in manuals, markings and placards under current Subpart G would be redesignated under Subpart O and amended to extend their applicability by including helicopters and approved Rotocraft Flight Manuals, manual materials, or placards, as appropriate.

3. *Helicopter Noise Rule.*—A proposed new Subpart H to Part 36 would prescribe the basic requirements for demonstrating compliance with the helicopter noise rules. The technical standards, conditions, and procedures for conducting helicopter noise tests and the helicopter noise limits under the proposed new Appendix H are specifically referenced.

4. *Noise Measurement and Evaluation.*—The proposed new Appendix H to Part 36 would contain, among other things, the technical noise measurement and evaluation specifications for conducting helicopter noise tests. With exceptions necessary to account for the distinguishing noise characteristics of helicopters, the FAA proposes to apply the specifications currently applicable to tests of transport category large airplanes and turbojet-powered airplanes under Appendixes A and B of Part 36 (as amended by FAR Amendment 36–9: 43 FR 8731; March 2, 1978).

The following highlights the proposed differences for helicopter noise tests under Appendix H from the requirements of Appendixes A and B:

a. Three noise test series would be used—takeoff, flyover, and approach noise test series with simultaneous measurements for each test series at a flight-track noise measuring station and two sideline noise measuring stations, one on each side of the reference flight track.

b. Airport reported wind conditions not exceeding 10 knots with wind direction within 15° of the reference flight track would be required.

c. The helicopter's height and lateral position over the noise measuring station would be relative to the center line of the reference flight path rather than the runway.

d. The approach angle for the helicopter approach noise test would be $6.0° \pm 0.5°$ rather than 3.0°.

e. The requirement regarding validity of test results within the 90 percent confidence limits for EPNL values would apply to each of the three noise test series—takeoff, flyover, and approach.

f. Numerous symbols and units for helicopter noise certification would be substituted for airplane symbols under the § A36.7 "Flight Profile Identification Positions" and "Distance-Unit-Meaning" descriptors used in Part 36. The proposal includes graphic depictions and textual descriptions of the various helicopter test profiles.

g. The FAA proposes the use of EPNL in units of effective perceived noise decibels (EPNdB) for determining the evaluation quantity of helicopter noise. Accordingly, the noise evaluation specifications under Appendix B may be applied directly to the measured helicopter noise test data. However, due to the noise characteristics of helicopters, the FAA is specifically considering the appropriate significance that should be given to identifiable "pseudo-tones" under the provisions governing corrections for spectral irregularities. Further, since each test series for helicopters consists of at least six test runs involving three noise measuring stations, the FAA proposes to require calculating a single, average EPNdB value at the three stations for each of the three test series (takeoff, flyover, and approach). Thus, that calculated EPNdB value would represent the numerical average of at least six separate, valid noise measurements for each test series at each of the flight track and two sideline noise measuring stations. Each calculated EPNdB value would then be compared with the noise level requirements to determine compliance.

5. *Noise Levels.*—The proposed new Appendix H to Part 36 would also contain the provisions governing helicopter noise levels for which compliance must be shown by actual flight tests. Those provisons include (1) "Stage 1" and "Stage 2" noise limits for each test series (related to the maximum certificated weight of the helicopter); (2) tradeoff provisions (governing limited "exceedances" of calculated noise levels for one or two test series when completely offset by reductions in the calculated noise levels of the other required calculated noise levels); and (3) separate test conditions for each of the three noise test series (including requirements for airspeed, altitude or operational profile over the noise measuring station, power, and helicopter position relative to the flight-track noise measuring station).

"Stage 1" noise limits represent the prohibition on noise level increases prescribed for "acoustical changes" of those helicopters which cannot achieve Stage 2 noise levels before a change in type design. "Stage 2" noise limits would be prescribed separately for the three test series (takeoff, flyover, and approach). The respective noise limits would range, according to maximum certificated weighs of the helicopter, between 86 and 106 EPNdB for takeoff, between 85 and 105 EPNdB for flyover,

and between 87 and 107 EPNdB for approach. Under the proposal, the highest noise limit applies to maximum weights of 176,370 pounds or more which is reduced by 3.01 EPNdB for each incremental, 50% reduction ("halving") of the 176,370-pound weight down to the lowest noise limit which applies to maximum weights of 1,764 pounds or less.

Tradeoffs of any "exceedances, like those for turbojet powered airplanes, would be limited to a sum not greater than 3 EPNdB with no single exceedance greater than 2 EPNdB. The exceedances must be completely offset by noise levels below those required for the other calculated noise levels.

IV. Regulatory History

On December 28, 1973, the FAA published an advance notice of proposed rule making (Notice No. 73–32; 38 FR 35487) in which it announced that it was considering proposing noise standards for aircraft that were expected to be developed for efficient short stage length operations. It was anticipated that such a class of aircraft, referred to as "short-haul," would include aircraft having short, reduced, or vertical (or near-vertical) takeoff and landing capabilities. Since the noise technologies appropriated to those aircraft as a separate class required further study, original FAR Part 36 in 1969 did not prescribe separate rules for those aircraft; some, such as helicopters, were not covered by any regulation. Notice No. 73–32 (ANPRM) was issued as part of that additional study to invite early public participation in the identification and selection of a course, or alternative courses, of action concerning the development of proposed noise standards which would provide relief and protection to the public health and welfare from aircraft noise. Under § 611 of the Federal Aviation Act of 1958, as amended (the Act), the FA Administrator, in prescribing or amending aircraft noise regulations is required to consider, among other things, whether the action is consistent with the highest degree of safety in air commerce and whether it is economically reasonable, technologically practicable, and appropriate for the particular type of aircraft to which it would apply.

As indicated in the ANPRM, the FAA recognized that many and broad problems were involved in developing an adequate proposed rule prescribing noise standards for all "short-haul" aircraft. The problems were compounded by the lack of any established operational or airworthiness definition of that class of aircraft which was expected to comprise a broad variety of aircraft configurations, propulsive systems, and operational capabilities and missions. For purposes of the ANPRM, those aircraft were tentatively described as being capable of executing at least six degree approaches and steep-gradient departures in routine operation and of operating on short-length, prepared surfaces (subclasses were specified according to the type of aircraft takeoff and landing capability and their other operational capability and mission).

The problems addressed by the ANPRM also included the possible role of short-haul aircraft in the future air transportation system with operations to and from airports, some in noise sensitive locations in or near densely populated and developed metropolitan areas with high-rise structures, other with little or no operational or noise sensitive area constraints. Comments were requested on the extent to which a proposed noise standard should not restrict their unique operational capabilities and whether the anticipated operational characteristics of the short-haul aircraft would be practically employed in actual commercial service.

The ANPRM discussed several of the known regulatory concepts for noise certification and testing methodology. The controversy concerning the use of EPNL as the basic noise evaluation unit was discussed but was not resolved as to the manner in which its use might affect any subsequent proposal. Sixteen topically broad questions were posed to assist commenters in reviewing the proposal and directing their views, data, and arguments in areas in which public comments and assistance would be most significant to the FAA in developing a proposed rule.

The FAA has carefully considered the comments received in response to Notice No. 73–32 in developing the proposed helicopter noise standards contained in this notice. General support was expressed for providing separate rules for different classes of short-haul aircraft, including separate rules for helicopters. The FAA agrees with those comments and thus is considering noise standards under FAR Part 36 for helicopters separately from those for other classes of aircraft. Discussions of comments and FAA's response to them are presented in the discussions that follow.

V. Aircraft Noise Rules

Pub. L. 90–411 and 92–574 were enacted to provide the statutory basis under the Federal Aviation Act, § 611, for promulgating regulations providing present and future relief and protection to the public health and welfare from noise and sonic boom from civil aircraft. Under those Acts, the Federal Aviation Administrator, after consultation with the Secretary of Transportation and the Administrator of the Environmental Protection Agency, is responsible for the adoption and amendment of rules which prescribe the necessary standards and regulations. On November 3, 1969, the Administrator adopted FAR Part 36 entitled "Noise Standards: Aircraft Type Certification" (34 FR 18355; November 18, 1969). That regulation initiated the FAA noise abatement regulatory program under the new statutory authority. It prescribed noise type certification standards for subsonic transport category large airplanes and for subsonic turbojet powered airplanes regardless of category or weight. Part 36 also prescribed the technical specifications for measuring and evaluating flight test noise data in demonstrating compliance with prescribed noise level limits.

Since the adoption of Part 36, the FAA has issued a number of notices proposing amendments to its provisions and, subsequent to notice and public procedure, has adopted those amendments which have been found to be consistent with the provisions of § 611 of the Act. Those amendments have increased the protection of the public health and welfare by providing the necessary control and abatement of aircraft noise and sonic boom. Further amendments and proposed amendments are currently under consideration by the FAA for future issuance.

In promulgating proposals and amendments under the authority of § 611 of the Act, factors which the FAA must consider include the following:

1. Available data relating to aircraft noise, including results of research, development, testing, and related evaluation activities.

2. The views and positions of other Federal, State, and interstate agencies.

3. Whether the proposed regulations are consistent with the highest degree of safety in air commerce and air transportation in the public interest.

4. Whether proposed regulations are:

a. Economically reasonable;

b. Technologically practicable; and

c. Appropriate for the particular type of aircraft, aircraft engines, appliance, or certificates to which they would apply.

5. The extent to which the proposed regulations contribute to providing protection to the public health and welfare by carrying out the purposes of

§ 611 of the Act. The overall environmental impacts of the proposed regulations (including environmental factors other than noise) must be assessed in accordance with the National Environmental Policy Act of 1969, and the implementing Federal guidelines and directives.

In response to statutory requirements to issue appropriate rules for the control and abatement of aircraft noise and sonic boom, the FAA has adopted several amendments to the FARs. A summary of those regulatory actions taken before 1977 is presented in the preamble to FAR Amendment 91–136 (41 FR 56046; December 23, 1976). Since that time, the FAA has issued four additional amendments to FAR Part 36—(1) FAR Amendment 36–7: "Noise Level Limits and Acoustical Change Requirements for Subsonic Transport Category Airplanes and for Subsonic Turbojet Powered Airplances" (42 FR 12360; March 3, 1977), which added, among other things, "Stage 3" noise limits that are more stringent than those in original Part 36 (now referred to as "Stage 2" noise limits); (2) FAR Amendment 36–8 (43 FR 8722; March 2, 1978; corrected at 43 FR 44474; September 28, 1978) which was the completement of Amendment 36–7, and prescribed more restrictive acoustical change requirements for "Stage 2 airplanes" with high-bypass ratio engines and brought Part 36 into greater conformity with international aircraft noise standards; (3) FAR Amendment 36–9: "Aircraft Noise Measurement and Evaluation Specifications" (43 FR 88731; March 2, 1978, corrected at 44 FR 3031; January 15, 1979) which up-dated and clarified the procedures and standards for conducting noise certification tests for the tranport category large airplanes and turbojet powered airplanes; and (4) FAR Amendment 36–10: "Civil Supersonic Airplane Noise and Sonic Boom Requirements" (43 FR 28406; June 29, 1978) which applied Part 36, with appropriate amendments, to Concorde SST aircraft. Thus, FAR Part 36 currently prescribes noise standard regulations applicable to the following aircraft classes:

1. Subsonic transport category large airplanes and turbojet powered airplanes (regardless of category or weight).

2. Propeller-driven small airplanes in the normal, utility, acrobatic, transport, and restricted categories.

3. Concorde civil supersonic transport airplanes.

VI. Need for Regulation

An FAA forecast indicates that during 1980 the civil rotorcraft fleet of 5300 aircraft will fly 2.1 million hours. Within general avaition, helicopters rank second to turbine-powered airplanes in the average number of hours flown per year (400 hours for helicopters compared to 540 hours for turbine-powered airplanes). The highest rate of aircraft utilization of helicopters, however, is forecast to remain in the civil air carrier fleet with approximately 2600 hours per aircraft during 1980. In addition, turbine-powered helicopters, which are generally more expensive than piston-powered helicopters, tend to have a higher utilization rate. The only scheduled carrier currently operating helicopters has a current annual per aircraft utilization rate of 1233 hours. On the other hand, the average privately owned helicopter is used for about 359 hours during the year while those owned by businesses for corporate/executive use have an annual utilization rate of 627 hours.

A 1976 industry directory of helicopter operators in the United States, Canada and Puerto Rico lists 2097 U.S. (including Puerto Rico) operators utilizing a fleet of 5030 helicopters. Business/executive use of helicopters in 1976 increased 29.9% (to 1082 operators) and the number of helicopters used for business purposes rose 31.8% (to 1392 helicopters). A 1977/78 industry directory of heliports also indicated that there are 3,286 public and private use heliports in the United States. Approximately 9% of these heliports are rooftop facilities located in urban areas.

Helicopters are being used as emergency, traffic control, and law enforcement vehicles. Victims of traffic accidents, natural disasters, or other emergencies are frequently transported by helicopter directly from the scene to hospitals or shock trauma centers. There were 699 hospital heliports in the United States, listed in the industry directory.

The emergency rescue capability of helicopters is fully recognized by responsible officials in several major metropolitan areas today. For example, city ordinances in Chicago and Los Angeles require that buildings above a certain height be provided with rooftop emergency landing facilities for helicopters because modern fire-fighting apparatus cannot reach above eight floors. As other municipal governments recognize the need to provide increased protection for high-rise inhabitants, the number of heliports for both routine and emergency uses may increase significantly.

A growing civil helicopter fleet combined with increased and more diversified uses of helicopters has intensified the demand for establishing additional heliports. However, concern for our quality of life has slowed the rate of heliport establishment and, in some instances, has caused various restrictions to be imposed on heliport operations.

In other cases, environmental pressure has forced the closing of certain heliports with the resultant loss of helicopter services at those locations. The FAA believes that the adoption of appropriate helicopter noise standards will help alleviate the adverse impacts on the public by reducing both the noise levels of helicopters and the trends toward impairing or losing the benefits of their services in the air transportation system.

In considering the noise standards in the proposed rule, it was necessary to consider the levels attainable from current production helicopters and the reductions in noise levels achieved by research demonstrators. To determine current noise levels, tests of actual in-service helicopters were conducted in 1977 by the FAA and the Department of Transportation at Dulles International Airport near Washington, D.C., and at NASA's Langley Research Center. This interagency effort was actively supported by the Helicopter Association of America and was, in turn, a part of larger cooperative venture by the International Civil Aviation Organization (ICAO). During these tests, noise data were recorded from eight representative types of helicopters. The testing consisted of hover, level flyovers at 500 feet and approaches on 3°, 6°, and 9° slopes. Data were processed in various noise units, (dBA, EPNdB, PNdB, PNdB(T), etc.) and the results are presented in Report No. FAA–RD–77–57, "Helicopter Noise Measurements—Data Report," April, 1977. These data are supplemented by other information available from the ICAO and published reports. Helicopter takeoff noise studies were included in FAA's recent studies at its National Aviation Facility Experimental Center (NAFEC) in New Jersey. Noise tests similar to those proposed in this notice were conducted on eight representative types of helicopters, including three of foreign manufacture. Those studies are reported in Report No. FAA AEQ–78–21, "Noise Levels and Flight Profiles of Eight Helicopters Using Proposed International Certification Procedures," Preliminary Report, August 29, 1978. Those reports are contained in the rules docket for this notice. Copies may also

be requested from FAA's Office of Environment and Energy, 800 Independence Avenue, SW., Washigton, D.C. 20591

In light of the considerations listed under § 611 of the Act, the FAA has also reviewed the helicopter as a noise source affecting persons and property in the areas in which they operate. Based upon its review and studies, the FAA believes that it should adopt appropriate helicopter noise regulations to provide the necessary relief and protection to the public health and welfare contemplated by § 611 of the Act. The FAA believes the proposals contained in this notice, if adopted, will achieve that objective by preventing further escalation of helicopter noise levels and laying the regulatory foundation for assuring that future helicopter types and eventually all newly produced helicopters of older type designs comply with firm but realistic noise standards. The FAA agrees with many commenters responding to Notice No. 73–32 that noise control technology exists which should be applied in the reduction of helicopter noise. The noise standards proposed in this notice are intended to accomplish that result consistent with the considerations under § 611(d) of the Act. The technical aspects of the need for the proposed regulation are discussed in more detail in the environmental assessment prepared in conjunction with this notice.

VII. Background of the Proposals

A. Overall Objectives

In developing appropriate noise rules for a new regulatory class of aircraft under § 611 of the Act, there are several general objectives. Those objectives were evidenced in adoption and subsequent amendments to FAR Part 36. Initially, noise standards should prevent further noise increases by older and current aircraft types. They should require new aircraft types and eventually newly produced aircraft of older types to comply with specific noise level limits. The noise test methodology for showing compliance should provide a basis for reliability and repeatability of test data which reflect the state of the acoustic arts and properly accounts for the noise characteristics of the aircraft without undue burden in conducting the tests. While the rules should be fair and impartial, they should not excuse the short-comings of design selection which does not take advantage of currently available noise technology. The FAA believes the regulation proposed in this notice accomplishes those objectives consistent with § 611 of the Act.

B. General Background

The helicopter is a complex vehicle form a noise standpoint. Significant noise producing components in the system include the rotor or rotors, engine, and gearbox. Differences in applied design technology cause somewhat different noise characteristics; some helicopters use a main rotor for lift with an antitorque tail rotor, other helicopters use fore and aft main rotors while others use meshing main rotors or dual contrarotating main rotors without a tail rotor. Main rotor configuration and operation also vary significantly from helicopter to helicopter. Some manufacturers use high tip-speed, two-bladed main rotors while other manufacturers use as many as seven blades operating at lower tip-speeds. Further, some aircraft manufacturers have developed "hybrid" aircraft which, to varying degrees, employ both wings of an "airplane" and an engine-driven rotor of a "rotorcraft" to furnish lift during takeoff, hover, or landing. Some of these aircraft are called "gyrodynes." To the extent that an engine-driven rotor is utilized to furnish lift, the aircraft shares many of the noise and performance characteristics of a helicopter. To avoid unwarranted discrimination in the application of the proposed standards and to ensure full evaluation of the § 611 considerations, including economic reasonability, technological practicability, and appropriateness to the type of aircraft to which the standards apply, this notice proposes to incude those "hybrid" aircraft that derive lift from an engine-driven rotor within the regulatory class of aircraft to which the proposals apply. However, the proposals do not apply to gyroplanes, whose rotors are not engine-driven, except for initial starting. Comments are specifically invited that provide detailed views and data concerning the regulatory, environmental, economic, and other relevant aspects of that proposal.

Research to establish theoretical prediction techniques for all of the significant helicopter noise producing components has been under way for many years with important success. However, there are some areas where the noise generation mechanisms are not well understood and where further work is required to achieve additional noise reduction. Fortunately, the helicopter as a military vehicle has benefitted from practical noise control studies oriented toward reducing its detectability in hostile environments. This has resulted in a body of knowledge which can be useful in minimizing annoyance for helicopters certificated for civil use.

Since its adoption in November, 1969, FAR Part 36 has been the basis for all Federal aircraft noise regulation in the United States. That regulation was structured to provide a firm, consistent foundation for subsequent rule-making activities to abate and control aircraft noise. Part 36, therefore, includes precise instructions concerning the acquisition and processing of noise data from in-flight aircraft. Differing acoustical test procedures and noise level requirements have been adopted as required to be appropriate for aircraft type. For instance, the provisions dealing with propeller-driven small airplanes (Appendix F) require horizontal flyovers at not less than the highest power in the normal operating range and the use of the dBA unit for noise evaluation; however, for transport category large airplanes and turbojet powered airplanes (Appendix C) there are three-point measurements involving takeoff, sideline, and approach noise. The noise evaluator for these Appendix C aircraft is the EPNdB. Thus, Part 36 prescibes rules that minimize the noise generated by aircraft of each regulatory class without requiring that the noise measurements, units, or limits themselves be identical for all classes. However, for each regulatory class, Part 36 requires application of the best economically practical technology appropriate to that class.

As discussed in Notice No. 73–32, air traffic constraints on the operation of helicopters in terminal areas may vary considerably and may be severe at large airports with little or no restaints at smaller airports and heliports. Similarly, the range of community noise sensitivity varies from critical at some metropolitan heliports to negligible at remote locations or at designated helicopter pads at major commercial airports. Thus, while some noise advantage can accrue from the unique operational capabilities of the helicopter (such as steep or vertical climb and descent), this advantage is sometimes negated by operational contraints or heliport size. Helicopters are often operated from small heliports in congested areas and flown at relatively low altitudes. As a result, the noise impacts of such aircraft can be significant to the surrounding communities.

Many of the respondents to Notice No. 73–32 pointed out another issue regarding helicopter noise type certification. This is the choice of an

appropriate noise descriptor unit. As discussed earlier, FAR Part 36 already employs two such descriptors, dBA and EPNdB. In proceeding with rule making, it is necessary for the FAA to consider whether either of these units, or a modification of one of them, or a totally different unit is appropriate for helicopters. To do this requires an examination of characteristic helicopter noise sources.

C. Helicopter Noise Sources

The principal noise sources of helicopters are those associated with the main rotors or main and tail rotors, drive engines, and gearboxes. These sources produce both broadband noise, extending over the entire audible spectrum, and discrete frequency noise, which may or may not itself be detectable to the human ear. Under certain flight conditions, helicopter rotors may also generate a distinctive impulsive noise, descriptively termed "blade slap" or "banging." However, blade slap often can be minimized or avoided operationally by using the proper combination of airspeed and rotor speed.

1. *Rotor Noise.* Rotors produce noise due to the fluctuating aerodynamic forces on the blades and the displacement of the air by the blade section. Also, at high tip-speeds and high flight speed, the flow over the blade section can exceed sonic velocity near the tip and a local, moving shock wave is generated. Finally, time-varying blade loads may occur due to interaction with atmospheric turbulence, tip vortices, or the flow from another rotor.

Characteristic rotor noise signatures consist of both discrete frequency and broadband components. The discrete frequency components are referred to as "rotational noise harmonics" and occur at multiples of the blade rotation (RPM) frequency. Rotational noise is a result of the pressure field caused by the rotor blade loading due to torque and thrust. Interaction with ingested turbulence or tip vortices can significantly increase harmonic content of rotational noise. Cyclic pitch and forward flight can give rise to a blade loading which varies once per revolution. Under certain conditions, this can cause impulsive noise, characterized by highly annoying "banging" sounds.

The origin of much of the broadband rotor noise is the turbluence contained within the air flow into the rotor blades. The FAA believes that prediction of rotor broadband noise, based on rotor geometry and operations, using empirical procedures has become highly acceptable. However, the success of such methods can be misleading in that they do not model the detailed acoustic and aerodynamic processes, but rely on generaliations of existing test data. However, the FAA believes that adequate rotational noise theory exists to make valid predictions of helicopter rotor noise. The limitation of these predictions appears to be that an adequate definition of the required input parameters, such as blade loading, is required for accurately predicting the noise. The FAA believes that additional work in this area on actual vehicles is necessary before noise reductions larger than those proposed in this notice can be achieved without resorting to costly empirical "cut-and-try" development of helicopter designs.

Impulsive noise can be considered as a special case of rotational noise. Interactions between tip wake filaments and the rotor blades are one major cause. Compressible aerodynamic effects are another major cause. One difficulty in calculating noise of vortex filament interaction is specifying the details of the aerodynamic flow immediately ahead of and around the blade. This is due to the complex and variable trajectories of the vortex filaments and the blades during operation. The impulsive noise that occurs during high speed cruise of a single rotor helicopter is believed to be caused by the increase in compressible drag on the advancing rotor blade due to the high resultant of rotational and flight speed. As in other rotor noise predictions, further study is needed on the specific quantification of the aerodynamic inputs required for the calculations. Further, it should be noted that the propagation of high-intensity, short-duration sound pulses, such as those generated by the above methods, is often different from that created by low-intensity, sound signals. Typically, these "finite amplitude" sounds have been studied in relation to a noise characteristic referred to as the "blast phenomena."

2. *Engine Noise.* Helicopter engines typically produce noise over a broad frequency range. In turbine engines, the compressor generally contributes to high frequencies while engine exhaust dominates at low frequencies, although high frequency turbine tones occasionally occur in the exhaust. Engine noise research has received recent attention because of its importance in turbofan engines. The noise components of engines identified in these studies are jet noise, combustion noise, turbine nose, and compressor noise. Jet noise in helicopters is not considered significant for today's helicopters because of the relatively low exhaust velocities of turboshaft engines as compared to turbojet engines. Combustion noise, which appears as a broadband noise that peaks near 400 Hz, is often the dominant component of noise from turboshaft engines, like those used on helicopters. Turbine noise appears at higher frequencies and consisits of tones and broadband noise. Compressor noise occurs at high frequencies and is the lowest level component of engine noise. Generally, compressor noise is most easily suppressed with sound absorbent duct liners.

Two basic approaches to engine exhaust noise suppression can be used. The first appraoch actually reduces the noise produced through changes in engine design or operating parameters. That approach appears promising for future engine designs, but may result in increased weight and size or increased fuel consumption when compared to current engine configurations. The second approach is the use of acoustically treated ducts to attenuate the noise generated. This approach increases aircraft weight and may adversely affect engine performance.

Turboshaft engines installed in helicopters greatly increase high altitude/hot day performance capabilities and are lighter in weight than reciprocating piston engines of comparable power. The lower weight powerplant increases the useful loads of helicopters. For example, a Bell 47G–4A is normally powered by a 305 horsepower piston engine weighing 444 pounds. The same helicopter has been modified to be powered by a 420 (derated) equivalent, shaft-horsepower, turbine engine weighing 158 pounds. Thus, the useful load of the turbine powered version is essentially increased by 286 pounds and the advantage of the increased high altitude/hot day performance capability attributable to the turboshaft power installation. However, that increased useful load and higher performance also involve the higher cost of the turboshaft engine. The FAA believes that the demand for lower priced piston powered engines will continue for many years filling the need for less expensive personnel, training, law enforcement, and light utility helicopters.

Noise control technology for piston powered engines can be applied to helicopters powered by those engines. Installation of improved muffler kits has greatly reduced the engine noise emitted by piston powered light helicopters. Hughes Helicopters has certificated its Model 300 CQ which, in addition to

having a dual muffler kit installed, may be flown in a quiet mode at 93% engine RPM. Operating in this mode at 50 MPH, the helicopter noise has been measured at 65 dBA at 500 feet vertical distance. Pending the availability of lower cost small turbine engines, small helicopters powered by piston engines will continue to enter the civil helicopter fleet well into the decade of the eighties. In the meantime, the FAA believes that the noise abatement methodology for small, piston engine helicopters can equal or better the technology applied to turbine powered small helicopters. Accordingly, the proposed rule applies to helicopters powered by both turboshaft engines and piston powered engines consistent with the considerations of § 611 of the Act.

3. *Gearbox Noise.* Gearbox noise sometimes can be detected in the noise signature of a helicopter due to direct radiation from the gear casing or from reradiation from the structure coupled to the gearbox. However, gearbox noise is not generally considered a significant exterior acoustic problem of current helicopters. Nevertheless, as quieter helicopters are developed in the future, they may require gearbox noise suppression. Significant progress has been made in understanding gearbox noise mechanisms over the past eight years. This has included development of both analytical and empirical noise prediction procedures. The empirical methods are relatively easy to use and offer reasonable accuracy in helicopter applications. Analytical methods, on the other hand, require a great deal of detailed design information and, at this time, still require some empirical corrections. The FAA believes that the empirical procedures are best used to estimate levels of existing gearboxes while the analytical procedures find their best application in diagnosing noise problems in new gearbox designs and developing source noise suppression techniques.

4. *Conclusion.* Extensive literature exists on the understanding, description, and prediction of these noise sources. Studies range from simple empirical equations showing the relation of a few gross design and operating parameters with the resulting noise to extensive open-form solutions requiring detailed design information which can be applied only by means of a high speed computer. The state-of-the-art in source noise understanding and prediction has by no means progressed to the point where all aspects of the theory have been fully developed. However, the solutions to fundamental noise problems are reasonably well understood and predictable in principle. Application of the currently available theories and methods to the designing or redesigning of components has generally resulted in noise reduction, although a deeper understanding in some areas, especially those related to broadband noise, is required to achieve substantial reductions without extensive developmental testing. The FAA believes that the noise standards proposed in this notice would prevent escalation of helicopter noise levels above levels supported by current technologies and provide a regulatory basis and incentive for future helicopter design developments to improve upon the state of the art.

D. Noise Tests

For all regulated classes of aircraft, except propeller-driven small airplanes (12,500 pounds or less maximum weight), FAR Part 36 prescribes noise standards in terms of a three-point measurement scheme. The purpose of those measurements is to adequately measure and limit noise emissions during both takeoff and approach by requiring the application of noise reduction and suppression technologies that are economically reasonable, technologically practicable, and appropriate for the particular type of aircraft. Since the major noise source of current conventional turbojet powered aircraft is the turbofan or turbojet engine, that three-point technique was designed to measure and limit the engine inlet, fan discharge, and core jet exhaust sound emissions. However, helicopters have considerably different noise sources and operational trajectories than conventional airplanes. Therefore, any appropriate rule must take into consideration these different characteristics and must fairly measure the noise in such a way that the noise reductions achieved through certification limits actually accrue to the benefit of the public health and welfare. Further, any rule should encourage the application of all appropriate noise control technology that is practicable within economically reasonable constraints and consistent with the highest level of flight safety. As an illustration, one of the most significant parameters to rotor noise source mechanisms is rotor tip-speed. However, limitation of tip-speed can lead to retreating blade stall, decreased autorotative capability, and diminished maneuverability. In addition, for a given airfoil, any significant loss of lift caused by lower speed must be offset by increased rotor solidity. To compensate requires either more blades or blades with wider chords. As an example, when Boeing Vertol modified a CH–47 Chinook helicopter as a demonstrator, the modifications included:

(1) Increased aft pylon height and longer fuselage to avoid tandem rotor blade/wake interaction.

(2) Advanced airfoils including thin tips to minimize vortex shedding.

(3) Four-bladed rotors, replacing three-bladed versions, to permit a decrease in tip speed.

Those modifications completely eliminated the blade vortex interaction noise resulting from the tandem rotors during forward flight. They also noticeably reduced rotational noise. The result in forward flight was a reduction of 23 decibels in the one-third octave band centered at 125 Hz. However, those changes may also result in corresponding (although not necessarily proportional) increases in direct operating costs and decreases in useful payload weights. For example, an industry report stated that a 10% decrease in rotor tip speed could result in approximately 6% decrease in payload weight.

An airfoil shape optimized for high-speed, low-noise forward flight is different from one optimized for hover performance. The differences in airfoil results in differences in both rotor aerodynamics, and noise signature. Thus, the acoustical characterists of a rotor that has been optimized for one type of operation may differ from the characteristics of a rotor designed for maximum performance in another operating mode. Since consideration of any noise certification rule promulgated under § 611 of the Act must include appropriateness to type of aircraft to which it applies, it is necessary to require adherence to standards that do not encourage meeting the prescribed noise limits by redesigning the aircraft for lower noise under one operating condition at the expense of significantly higher noise at other modes in which the helicopter may be operated. FAR Part 36, Appendix C, addresses this issue for subsonic turbojet powered aircraft by setting takeoff, sideline, and approach noise standards. In fact, measurements of sideline noise at several locations are required to assure that fan exhaust noise along the sideline during takeoff does not increase disproportionately as jet noise radiated rearward is diminished. For helicopters, the requirements to demonstrate the balanced application of appropriate noise reduction technoloy can be met by the use of three relatively simple flight test procedures indicative of standard operations. These are: (1) A takeoff noise test; (2) a flyover noise test; and

(3) an approach noise test. A separate hover noise test was considered but is believed to be unnecessary since (1) the blade design technology which would be demonstrated by such a test is equally evident to sideline microphones during the takoff, flyover, and approach flight test procedures, (2) hover time represents less than one percent of the operating time of helicopters during normal operations, and (3) narrow band frequency data of hover show evidence of a ground-plane-reflection effect which complicates the repeatability and reliability of these data under separate tests.

Thus, the three flight test series and the noise measuring points were selected to require the balanced application of available noise reduction technology to certification of helicopters under the proposal. The interrelationship of noise levels, test methodology, and noise measuring points results in a noise standard that achieves the greatest noise reduction consistent with the considerations under § 611 of the Act. Necessarily, under the proposed standard those factors are interdependent in achieving the noise reduction objectives. The selection of the particular levels, methodology, and distances for the proposed rule accounts for the operating noise emission characteristics of helicopters. The FAA believes the computation of three average noise values, one for each flight test series, ensures that the recorded noise data in each three microphone array properly reflects the full range of data produced during each noise test and the appropriate weighting of measured noise levels at each noise measuring point.

The FAA believes that the versatile operational performance capabilities of helicopters require noise certification test and measurement conditions which differ slightly from those currently applied to airplanes. For example, a six degree approach is proposed to accomodate the helicopter's ability to conduct steep approaches at relatively show airspeed. For the takoff test, the microphone is proposed to be located only 1650 feet from the point at which takeoff power is applied to permit the measurement of the noise levels of the helicopter while in the best rate of climb attitude at high power and rotor settings. In the flyover series, the reference speed proposed is 90% of either the maximum speed in level flight with maximum continuous power (V_H) or the never-exceed speed (V_{NE}), whichever is lower, since it represents a high cruise speed in level flight at a high gross weight and high power and rotor settings. The noise levels recorded at the measuring points are expected to represent those which can be achieved using normal piloting techniques in the heliport/helistop operating areas. The FAA believes that the proposed test conditions can be duplicated practicably and safely in normal operations and the resulting noise levels are those that flight crews can achieve by using normal helicopter operating techniques.

E. Noise Descriptor Unit

Various noise rating scales intended to accurately assess the subjective, or perceived, response to aircraft noise have been investigated for more than twenty years. Some difficulties of conducting meaningful tests occur where the results are determined by persons judging different types of sounds (particularly in test chambers using recorded aircraft sounds). Those tests have led to considerable confusion about the various rating systems and units. Since the noise description unit chosen for use under the proposed standard must be appropriate to helicopters, the FAA, in association with the International Civil Aviation Organization (ICAO), Working Group B, has devoted considerable attention to the technical consideration underlying that selection. Particular attention was paid to the two noise units (dBA and EPNdB) currently used in Part 36 and to variations of those units. As previously indicated, the dBA unit is currently used for propeller-driven small airplanes (12,500 pounds or less maximum takeoff weight), while the EPNdB unit is used for all transport category large airplanes (above that weight) and turbojet powered airplanes, including Concorde supersonic transport airplanes (SSTs).

The EPNdB unit was not adopted for the lighter weight propeller-driven airplanes because it was found to be unnecessarily complex for the nature of the noise problem being regulated. Instead, the dBA unit was chosen to make the measurements of noise from light, propeller-driven airplanes more compatible with measurements used for the broad range of industrial and transportation noise sources. However, most recognized noise problems that occur as a result of helicopter operations (even for small helicopters) more resemble those encountered with transport category and turbojet airplanes than those from the light, propeller-driven airplanes. This is, in part, because helicopters are most often operated in support of commercial or industrial activities rather than as personal or pleasure aircraft. Also, because of their unique operating characteristics, they often operate at or near both maximum weight and maximum speed at relatively low altitudes over and near urban and other populated areas. Therefore, a unit that accounts for both the presence of tones and the duration of the noise is believed to be appropriate. Since industry, citizens' groups, and governments at all levels have found the EPNdb to be useful in describing and controlling most airplane noise impacts around airports, the FAA proposes the use of this unit for helicopters also. Obviously, there are other potentially useful units and rating systems that either have been or could be devised that also meet these criteria. However, this unit has several advantages. It is already used for certificating a wide variety of other regulated aircraft classes and, therefore, noise impact comparisions among those classes can most readily be made in this unit. In addition, significant amounts of data from current helicopters already exist in this unit which help provide a basis for the FAA to set appropriate noise certification compliance levels.

The FAA has carefully considered alternative versions of and corrections to the EPNdB unit that might be employed. For example, the FAA conducted flyover test demonstrations to determine the usefulness, if any, of several evaluation procedures that included correction penalities for impulsive noise ("blade slap"). After careful consideration and evaluation of the human response data from these tests, it is believed that, at this time, no conclusive support exists for adoption of one proposed adjustment method over another or for any adjustment at all. The impulsive corrections imposed specifically to account for incremental changes in annoyance associated with blade slap have not proven effective. Further psychoacoustic studies should be conducted to determine if subjective response to helicopter impulsive signals would require an annoyance increment to be added to the certification noise unit. However, EPNL at least partially accounts for the reported annoyance due to blade slap. Further, the use of EPNL is fully consistent with current certification procedures. The environmental assessment prepared in conjunction with this notice discusses in greater detail the FAA and NASA reports which form the basis for these conclusions. Thus, the FAA proposes that the unmodified Part 36 EPNdB be employed in the measurement and certification of civil helicopters. Additionally, blade slap is not expected to be present in new technology

helicopters at the noise levels being proposed for certification.

F. Noise limits

In considering the noise level standards to be incorporated into the proposed rule, it was necessary to consider the levels attainable from current production helicopters and the reductions in sound levels achieved by research demonstration. Work on the specific helicopter noise standard issues was begun in 1974 and has been a process involving the FAA, the ICAO, the U.S. helicopter industry through the Helicopter Association of America, the Transportation System Center, the National Aeronautics and Space Administration and the International Standards Organization. Even before the testing methodolgy and noise descriptor unit were selected, the FAA and the ICAO began gathering aircraft noise level data that were taken in accordance with, or correctable to, the alternative procedures selected, including many expressed in terms of EPNL. In some cases, data taken by various countries in evaluating the efficiency of the various testing methodologies and procedures were already available. However, the FAA felt that additional aircraft should be examined in order to evaluate the noise levels attained by current production helicopters and the reductions achieved by research demonstration.

To determine current noise levels, tests of actual in-service helicopters were conducted by the FAA, as part of larger cooperative venture by the ICAO. During these tests, noise data were recorded from eight representative types of helicopters: The Hughes 300C and 500C; the Bell 47G, 206L, and 212 (UH-1N); the Sikorsky S-61 (SH-3), and S-64, and the Boeing Vertol 114 (CH-47B). The testing consisted of hover, level flyovers at 500 feet, and approaches on three, six, and nine degree glide slopes. Data were processed in various noise units, such as dBA, EPNdB, PNdB, and PNdB(T). Additional data were acquired at the FAA's National Aviation Facilities Experimental Center during June, 1979. The flight procedures proposed in this notice (including takeoff, flyover, and approach) were utilized to examine eight types of helicopters. The data acquired is being used to (1) test the feasibility of these FAA developed flight profiles for helicopter noise certification, (2) demonstrate the repeatability of each flight profile by various types of helicopters, and (3) acquire a combination of noise/altitude data on a mix of current production helicopters. These data were supplemented by other data available from the ICAO and other published reports. In all, data from 23 different helicopter models and types were compiled. The table below summarizes the measured noise levels of each helicopter and indicates the noise limit that would apply to that weight aircraft under the proposed noise limits.

In setting a noise level limit under § 611 of the Act, the FAA must consider, among other things, what is "economically reasonable" and "technologically practicable." These considerations have been reflected generally in previous rule making by requiring the application of the best of the currently in-use noise abatement and suppression technologies. The FAA believes that application of a technology in current production or design by at least one aircraft manufacturer provides a strong indication that that technology should be incorporated to satisfy the statutory requirements under appropriate rules. However, care must be taken to ensure that the demonstration of technology application is typical of a broad range of aircraft within the particular regulated class and not just for special purpose, or limited mission aircraft. In this manner, the proposed limits also demonstrate what may be appropriated for the particular type of aircraft to which the limits would apply. For helicopters, there is not just one technology or technique whose use will ensure an economically-viable, low-noise aircraft; rather, there is a family of technologies and related good engineering practices. Quiet helicopters are being developed today because the tradeoffs between source noise and operational productivity are fairly well understood and predictable. The FAA believes that appropriate balancing of these tradeoffs can lead to a better performing helicopter, since it has been shown that frequently what is good for noise reduction is also good for the economic viability of the aircraft in general.

BILLING CODE 4910-13-M

Aircraft Type	Test Weight lbs.	Noise Levels EPNdB					
		Take-off		Approach		Level Flyover	
		Meas.	Limit	Meas.	Limit	Meas.	Limit
H 300C	1804	-	86.1	-	87.1	80.6	85.1
H 500C	2250	85.1	87.1	87.7	88.1	85.8	86.1
Bell 47G	2728	-	87.9	89.6	88.9	90.3	86.9
SA 341G	3970	92.5	89.4	89.5	90.5	86.1	88.5
Bell 206L	4000	85.9	89.6	90.3	90.6	85.8	88.6
AS 350	4180	89.2	89.7	91.2	90.7	87.2	88.7
SA 342	4180	-	89.7	95.5	90.7	88.2	88.7
BO 105	5070	89.1	90.6	91.7	91.6	88.4	89.6
A 109	5390	-	90.9	93.0	91.9	90.4	89.9
SA 360	6600	92.4	91.7	-	92.1	-	90.1
SA 365	7480	-	92.3	94.0	93.3	89.4	91.3
MI 2	7755	-	92.4	96.1	93.4	89.5	91.4
WG 13	9350	91.6	93.2	96.9	94.2	97.7	92.2
Bell 212	10500	91.7	93.7	95.7	94.7	94.6	92.7
SA 3305	15532	95.4	95.4	95.6	96.4	91.4	94.4
SA 330J	16280	97.8	95.7	96.1	96.7	93.6	94.7
S-61	22050	95.9	97.0	94.0	98.0	92.6	96.0
MI 8	25212	-	97.6	99.6	98.6	97.3	96.6
SA 321F	25300	98.4	97.6	98.6	98.6	92.0	96.6
S-65	37000	95.7	99.2	99.9	100.2	97.1	98.2
CH 47	40920	-	99.7	105.4	100.7	107.6	98.7
S-64	42812	-	99.9	98.6	100.9	96.7	98.9
MI 6A	88440	-	103.0	107.4	104.0	103.4	102.0

BILLING CODE 4910-13-C

While the requirement for consideration of standards that are "economically reasonable" may mitigate against requiring application on any one helicopter of the full range of proven sound attenuation techniques, two separate government-funded programs found that reductions of the order of 12 PNdB were attainable from widely divergent helicopters, the Hughes OH–6A and the Boeing Vertol CH–47C. The manufacturers of these helicopters now offer models that are from six to ten EPNdB quieter for their weights than the previously tested unmodified OH–6A and CH–47C helicopters. Accordingly, the FAA believes that economically reasonable and technologically feasible noise level limits can be established and that the limits proposed in this notice achieve that objective as part of an integrated and comprehensive noise standard. The proposed noise limits for each test series (takeoff, flyover, and approach), are proposed in conjunction with the proposed noise measurement, evaluation, and calculation specifications.

From the noise test data collected and analyzed, the FAA believes that the maximum helicopter weight to noise level ratio represents an increase of 3.01 dB for each doubling of the maximum weight. Both the FAA and the ICAO technical working group have, therefore, proposed noise standards which reflect that relationship. Under the proposal, for each noise test series, the highest noise limit, which is for maximum weights of 176,370 pounds and more, is reduced by the 3.01 EPNdB ratio for each "halving" of the 176,370-pound weight down to the lowest noise limit for maximum weights of 1,764 pounds and less. For takeoff noise the proposed noise limits varies according to maximum weights between 86 and 106 EPNdB; for flyover noise, between 85 and 105 EPNdB; and for approach noise, between 87 and 107 EPNdB. Based on its review of helicopter noise levels and a recent study to determine economically reasonable and technologically practicable noise limits, the FAA believes that these proposed noise limits are consistent with the considerations of § 611 of the Act. A more detailed discussion of the proposed noise limits and their basis is contained in the environmental assessment of this proposal.

Under the proposed tradeoff provisions, the calculated noise limits may be exceeded for one or two noise test series if the sum of any exceedances is not greater than 3 EPNdB while any exceedance for any single test series is not greater than 2 EPNdB and any exceedances are completely offset by nosie below those required for the remaining calculated noise levels. As for turbojet powered aircraft under Part 36, permitting these limited exceedances for helicopters provides needed flexibility in design parameters within reasonable noise prediction tolerances.

G. Noise Measurements and Evaluation

The FAA proposes to require that sound pressure level data for helicopter noise certification be obtained, recorded, and analyzed with acoustical equipment under measurement and evaluation procedures substantially as prescribed in current Appendixes A and B of FAR Part 36. However, certain substitute requirements, which are specifically identified as such in the text of the rules, are proposed to better account for differences in helicopter noise characteristics from those of conventional airplanes. For example—

1. Separate noise level data from these three flight test series (takeoff, flyover, and approach) would be recorded by an array of three microphones at noise measuring stations 492 feet apart along a straight line perpendicular to the reference flight track. The center microphone, at the flight-track noise measuring station, would be directly under the reference flight path, 4 feet (1.2 meters) above the ground.

2. The flight-track noise measuring station would be overflown at least six times for each of the three noise test series (3 in each direction for the flyover test). As under current Appendix A, after correction and adjustment, the test results would be required to produce average EPNdB values (and their 90% confidence limits) for each test series. The samples must be large enough to establish statistically the required 90% confidence limits not exceeding ± 1.5 EPNdB for each test series. No test result may be omitted from the averaging process, unless otherwise specified by the FAA. The calculated average EPNL values for each test series, within the 90% confidence limits obtained by the foregoing process would be those by which the noise performance of the aircraft would be assessed against the noise certification criteria, and reported to the FAA.

The FAA is also considering alternative proposals regarding the permissible exclusion of certain "pseudotones" from the calculation of tone corrections in computing the Effective Perceived Noise Levels (EPNL) for helicopters under proposed § H36.201. Under § B36.5(m), which might be incorporated by H36.201, tones resulting from ground-plane reflections in the 800 Hz and lower one-third octave bands may be excluded during the calculation of the tone correction used in computing the EPNL. To qualify for this exclusion, the pseudotones "must be clearly identified as not being related to the engine noise." However, while they may be excluded from the tone correction they are included in the noy calculation portion of the EPNL computation.

That permissive exclusion (at the option of the applicant) was included in Part 36 to avoid penalizing applicants for nonaircraft related effects resulting solely from the geometry of the microphone installation during aircraft tests. Such pseudotones are seldom, if ever, discernible by people exposed to conventional turbojet aircraft noise but have been shown to artificially influence the computed EPNL value. The objective of noise certification is to require the application of the best economically reasonable noise reduction technology to further protect the public health and welfare. Therefore, exclusion of pseudotones for turbojet and turbofan powered aircraft is justifiable when those tones are not related to the application of technology or to the public health and welfare.

In its decision to recommend the use of EPNL for helicopter noise certification, the ICAO technical working group examined the efficacy of also applying the pseudotone exclusion to helicopters. However, because of the pronounced low-frequency tonal characteristics of helicopter noise (particularly in the presence of blade slap), they found that removal of the pseudotones could interfere with an adequate assessment of the effects of helicopter noise. Further, the use of the average of three microphones for helicopters instead of the one used for turbojets, appears to blur the influence on the reported EPNL.

The FAA believes, based on current analysis, that the ICAO assessment is correct. Accordingly, proposed § H36.201(b) would specifically disallow exclusions of pseudotones from tone correction calculations. However, the FAA also believes that further technical investigation is needed to support adoption of that proposal. Thus, comments are specifically invited which provide technical data and analysis on that issue.

H. Acoustical Changes

Under the proposal, acoustical change approval would be required for changes in type design involving (1) a change to, or by removal of, a muffler or other

component designed for noise control, (2) any design change which results in an increase in maximum rotor RPM, maximum continuous power, takeoff power, or maximum takeoff weight; and (3) any other design change that the Administrator determines might increase the noise levels of that helicopter. While helicopter design and performance changes and noise are closely related, they are also quite costly. The FAA also notes that helicopter derivatives are usually growth versions with increased payload or operating range and, thus, increased weight. The costs of redemonstrating compliance with airworthiness requirements by these heavier versions is quite high due to the primary and secondary effects of those changes on the airworthiness characteristics of the "parent" helicopter type. The FAA believes that most acoustical changes would result from design changes made by the holder of the type certificate rather than individual owners of the helicopters. However, the proposed rule applies to design changes regardless of who makes them or whether the changes are to an in-production or post-production aircraft. Thus, all design changes that might increase noise levels would be covered by one or more of the proposed acoustical change elements and those kinds of changes that the FAA believes inherently affect noise levels are specifically identified. Other design changes must be analyzed to determine whether they might involve noise increases.

Acoustical change approvals applied for on or after the effective date of the rule would be governed by one of the three basic requirements. Any Stage 1 helicopter before a change in type design would not be permitted, after the design change, to increase any noise level created prior to the change in type design. Each Stage 2 helicopter before a change in type design, would be required to continue to be a Stage 2 helicopter by showing compliance with Stage 2 noise levels after the design change.

I. Operating Limitations and Information

Under the proposal, as is currently required for other aircraft under Subpart G, the test procedure used for noise certification, the required "no determination" statement, and the certificated noise levels would be provided in any combination of approved rotocraft manual material, markings, and placards. If the helicopter is noise certificated at less than the maximum certificated weight, that lesser weight must be shown as an operating limitation.

VIII. Comments to Notice No. 73–32

As previously indicated, interested persons have been afforded an opportunity to participate in the development of proposed short-haul aircraft noise regulations, including those which would apply to helicopters. Those comments received have been reviewed and duly considered in proposing this rule-making action. Nineteen commenters responded to the ANPRM (Notice No. 73–32). Comments were received from foreign and U. S. governmental agencies, foreign and domestic aircraft and aircraft engine manufacturers, and aviation trade/industry associations. The issues addressed by the commenters were mainly those objectives and inquiries posed in the ANPRM. Of particular importance to this notice, the comments addressed the prematurity of proposing noise regulations at this time for short-haul aircraft as a whole or for aircraft subclasses other than helicopters. Many commenters offered general support for, and recommendations regarding, the form and substance of separate proposed noise rules for helicopters.

As noted by several commenters, many aircraft with short or reduced takeoff and landing characteristics are currently type certificated under airplane categories already subject to the noise standards under Part 36 (Subpart A, covers transport category large airplanes and turbojet powered airplanes, and Subpart F, covers propeller-driven small airplanes). As vertical and short takeoff and landing airplane technology advances, it may be appropriate for the FAA to consider and adopt airworthiness and environmental standards separately for new or revised classes of aircraft. This notice, however, proposes noise regulations only for helicopters in the normal, transport, and restricted categories for which airworthiness standards already exist under FAR Parts 21, 27, and 29. This response to comments submitted to the docket for Notice No. 73–32 focuses primarily on those issues affecting a proposed helicopter noise standard. However, while the FAA has decided not to proceed with proposed rule making at this time except for helicopters, these matters concerning nonhelicopter issues have been fully considered. That decision does not commit the FAA to a particular course of action in any future regulatory proceeding regarding airworthiness or environmental regulations concerning advanced technology vertical or short takeoff and landing aircraft as separate regulatory classes. The comments submitted are discussed as follows:

A. A "Short-haul" Aircraft Class

Most commenters addressed the use of the term "short-haul" to describe the affected class of aircraft and the criteria for defining the composition of that class. From the various views, the disagreement among commenters was clearly evident regarding the prospective regulatory class and which characteristics of the various aircraft discussed in the ANPRM should control in determining appropriate classes and subclasses. Most comments pointed up the complexities and competing objectives involved in attempting to define for noise regulation purposes a broad, yet undeveloped class of aircraft for which no separate airworthiness standards have been prescribed. However, many commenters recognized the commonality among, and unique characteristics of, helicopters. Most of those commenters viewed the helicopters as a readily identifiable class for which there is a demonstrable need to develop and prescribe noise standards separately from other possible shorthaul aircraft subclasses. (Since the ANPRM used the term "short-haul" to identify the affected class of aircraft, that term is used in this notice rather than any other, sometimes more descriptive, term suggested by commenters.)

The FAA agrees that a satisfactory definitional basis of "short-haul aircraft" for noise purposes is still lacking. It also agrees with the suggestion that it may be necessary to prescribe individual standards for various subclasses of short-haul aircraft. Helicopters are distinguishable from other possible short-haul aircraft subclasses. Helicopters do not require the same facilities as fixed-wing aircraft. They have different operating and noise emission characteristics from other aircraft. Siting considerations for many heliports differs considerably due to the operational characteristics of helicopters. The FAA believes the rule proposed in this notice reflects those distinctions and provides appropriate noise standards consistent with airworthiness regulations and would generate information on measured noise levels that are indicative of actual in-service helicopter performance. Within the framework of current FAR Part 36, the FAA believes it can adopt noise rules that are appropriate to helicopters and compatible with the structure and concepts of current noise rules. This can be accomplished without patchwork

regulations feared by some commenters. Neither does the proposal establish the unnecessary illusion that, for noise purposes, most, if not all, aircraft are of a single class and should be treated identically under the rules.

The FAA does not agree with the suggestion made by one commenter that this proposed rule should begin by certifying heliports rather than, or in addition to, noise type certification of helicopters. The FAA does not dispute the interrelationships among the factors of aircraft noise levels, operational capabilities, market economics, and airport noise sensitivity in considering the full helicopter noise problem. The FAA agrees that an adequate resolution of those problems frequently must include both aircraft noise regulations and complementary airport noise planning and implementation. However, the FAA believes that the important initial step for the Federal government is to promulgate aircraft noise standards which preclude further escalation of helicopter noise levels and provide the basis for assessing compatibility of operating certain helicopter types in the future at specific locations. Thus, this notice is not intended, and cannot be considered, as leading to rules that would provide the complete resolution of all matters concerning helicopter noise impact on local airport communities. However, within the structure and purpose of FAR Part 36, it proposes the necessary, initial noise type certification standards for helicopters.

As currently stated in § 36.5, which would also apply to certificated helicopter noise levels, "[n]o determination is made, under this part, that these noise levels are or should be acceptable or unacceptable for operation at, into, or out of, any airport." That position is in conformity with the authority and responsibility of the airport proprietor concerning "local option" under the Federal Aviation Noise Abatement Policy, issued by the Administrator and the Secretary of Transportation on November 18, 1976.

Several commenters responded to the objective stated in the ANPRM regarding the extent to which the definition of short-haul aircraft should include assessment of the economic impact and technological feasibility of responsive noise rules.

The FAA agrees with commenters who felt that, while an appropriate regulation would be fair and impartial and not excuse economic or technological shortcomings of certain aircraft characteristics, it should fully account for the economics and technology for maintaining or reducing the impacts on the airport environment. It should do so without needlessly restricting development of aircraft whose operating characteristics are essential if the desired air transportation services at properly designed close-in facilities are to be provided. The FAA believes that it is premature to assess with any degree of confidence the extent to which economic and technology considerations should influence any proposed rule for short-haul aircraft other than helicopters. The differing views and suggestions of commenters on these matters are a further indication that the resolution of the controlling questions involved has not been sufficiently developed for any other regulatory decision to be formulated at this time. Thus, this notice proposes noise standards only for helicopters.

B. Prediction of Noise Level Characteristics

In the ANPRM, the FAA stated its concern on whether it was advisable, or possible, to attempt to set noise standards before the development of a short-haul class of aircraft. Several commenters pointed out that while various noise characteristic prediction methods have been applied to a number of individual aircraft types that might be included in a short-haul or other separate regulatory class, there is no experience which can be viewed as supporting generalizations of those methods to other situations. The problem is not made easier by the lack of a current definition of the potential regulatory class to which the methodology would apply. Landing and takeoff noise characteristics are extremely difficult to predict accurately with any degree of certainty. According to some commenters, many techniques tend to work only to a particular manufacturer's design details and the resulting acoustics data are not generally exchanged among manufacturers, primarily for competitive reasons. Thus, no broad critique of those individual methods had been done by the aviation industry at the time the comments were submitted.

Despite the generally negative tone of comments received on this matter, the FAA notes with encouragement that it has since become the subject of continuing discussion and that most commenters were more positive in their views at that time concerning the availability and development of predictive methodologies for helicopters. Since the FAA is not concerned *per se* with predicting precise noise levels for regulatory purposes, the helicopter's already advanced stage of development and use provides a workable basis of measured noise and performance data of existing types. Further, since 1973 when the ANPRM was published, specific attention and study of helicopter noise characteristics has added considerably to the body of knowledge. FAA's interest in the existence of adequate prediction techniques is in ascertaining whether manufacturers are able to determine which design features must be considered for incorporation at early stages of the designing process to assure their application in new or modified designs. The FAA believes that, based on the comments and its own studies, that capability exists for helicopters; it is improving, and for helicopters as a regulatory class, that capability can and should be applied.

C. Application of Noise Techniques

Many of the commenters responded to the ANPRM inquiry into the extent to which noise reduction methods for "conventional" aircraft can be applied as noise reduction techniques for the various aircraft considered for inclusion within the class of short-haul aircraft. Commenters noted that, except for rotor-wing aircraft, current Part 36 already applies to most of those aircraft included in the proposed short-haul regulatory class. Thus, the issue of noise reduction is essentially whether, and, if so, to what extent under § 611 of the Act, those aircraft should be governed by noise standards specifically tailored to a new class of aircraft in order to account for their distinctive takeoff and landing characteristics. Some commenters pointed out that noise technologies used for conventional aircraft types have limited application or influence on design options that have noise emission consequences for short-haul aircraft. To some, current Part 36 is believed to be ill-suited to provide appropriate noise standards. However, most commenters felt strongly that it is premature to attempt to define a new regulatory class in the absence of separate airworthiness rules or any other correlation among any distinctive performance or environmental characteristics. As previously discussed, the FAA agrees that a satisfactory definitional basis of short-haul aircraft for noise purposes is still lacking and, thus, consideration should be given to other reasons for separate classes of noise rules before a regulatory decision to proceed with rule making can be made. As shown by the differing views and suggestions of commenters, a resolution of the central issues involved

has not been sufficiently developed for any other regulatory decision at this time. The FAA is continuing to monitor developments in those areas and to provide opportunities for directed inquiries into promising areas of investigation. As progress is made, the FAA will consider additional rule making to provide any appropriate amendments to the noise standards under § 611 of the Act.

Several commenters addressed the noise reduction capabilities for helicopters and identified the three main noise sources as engines, rotors, and gear boxes. They generally agreed that engine and gear box noise can effectively be reduced significantly using existing techniques. However, commenters were less optimistic regarding the extent to which rotor noise can be dealt with under then existing methods. At the time comments were prepared, changes in main rotor blade tip speeds had produced some noise benefits but it was felt that the fundamental characteristics were not well enough understood to assume definite benefits would generally be achieved. When tail rotor noise is a factor, commenters were particularly pessimistic about significant results based on the then current knowledge of the means for noise control.

The FAA agrees that there is a reasonable basis for confidence that engine and gear box noise reductions can be achieved. However, the FAA believes that acoustic theory and the state of the art has progressed sufficiently that rotor (both main and tail) noise can also be reduced significantly if noise reduction is a serious design goal just as it is with other performance type parameters. These matters are discussed previously in greater detail under the background of the proposals.

D. Specific Noise Measuring Points

The FAA requested comments regarding whether it is practical to identify specific noise measurement points for certification purposes to provide recorded noise data for the short-haul class of aircraft which can also be used for long range land-use planning and future airport development. Of particular interest to the FAA was the utility of the current Part 36 three point concept for that purpose. Comments were also requested concerning a fourth, more distant, approach noise measuring point to enhance assessment of approach noise levels.

Most commenters, in general, supported the present three point concept for measuring aircraft noise (takeoff, sideline, and approach). Some, however, suggested that in order to account for different characteristics of the aircraft or community noise impacts at various airports for short-haul aircraft, the definitive points should vary in distance. The suggested distances included those from the aricraft (or from the start of takeoff roll or the approach threshold) (1) according to the type of operation for which the aircraft is designed and would be used, (2) according to means of propulsion and lift, or (3) according to the characteristics of the airports it would serve. One commenter noted that no three-point data alone provides adequate information for detailed and specific land-use planning or future airport development. Other commenters stated that the current three-point concept should not be applied directly to helicopters due to their unique operating characteristics. Some commenters supported a two-measuring point approach test to account for aircraft using approach profiles other than a straight, constant speed, gradual descent type profile.

The FAA does not fully agree in all respects with those views. The noise measurement concepts under Part 36 are not intended to prescribe fundamental design parameters of the regulated class of aircraft, to serve as the basis for particular operating procedures or techniques, or by themselves, to be used in developing airport noise plans and implementation. The purpose of noise type certification, based on appropriateness to the type of regulated aircraft, is to ensure the maximum utilization of economically reasonable and technologically practicable noise suppression methodology in the design and construction of aircraft. While additional benefits may be derived from appropriate noise abatement operating rules, the FAA finds no basis to justify reliance on those rules as the sole, or primary means of controlling and abating aircraft noise. The FAA agrees that the noise measuring points for helicopters should not be those currently applied to turbojet powered airplanes but should account for the operating and noise emission characteristics of helicopters. The FAA believes the proposal contained in this notice provides noise measuring points for each noise test series which, when taken together, properly account for those characteristics.

E. Costs and the Rule Concepts

Virtually every commenter expressed doubt that there existed an adequate basis for identifying and quantifying the costs associated with the numerous regulatory concepts which could be proposed to account for the large variety of noise characteristics of a regulated class of short-haul aircraft. Most felt that, until the economic aspects are developed and assessed, any attempt to meaningfully select among alternative regulatory standards is premature and ill conceived. Many suggested that the aircraft data that was available to manufacturers showed an extremely broad range of potential operating and noise emission characteristics for the class of aircraft that would be affected under the ANPRM objectives. Several commenters recommended regulatory concepts which would tie noise type certification and noise levels to specific airport operations to achieve maximum compatibility without undue restrictions on aircraft type designs.

Since in promulgating aircraft noise rules, it must consider whether a proposal is economically reasonable and technologically practicable, the FAA agrees that data involving the cost effectiveness of alternative noise rules considered for application to the broad class of short-haul aircraft identified in the ANPRM have not been developed. Rather than providing a basis for selecting among identified alternatives, the comments as a whole involving the economics of a proposed rule generally pointed out the complexity of developing a broad class noise rule envisioned by the ANPRM objectives. The FAA agrees that an important factor in deciding whether to propose a rule for a particular class of short-haul aircraft is the availability of reliable engineering, economic, and noise data in sufficient quantities for those aircraft. Based on comments to the docket and FAA's review of other information available to it, the FAA believes that a single identifiable regulatory class of aircraft has not yet emerged and that necessary economic data is likewise lacking in adequate detail to permit the development of such a rule. However, the FAA believes there is sufficient certification and noise data regarding helicopters as a class to propose noise standards applicable to helicopters. As the necessary data becomes available, development of additional rules may be considered for an identifiable regulatory class of short-haul types of aircraft.

While the FAA believes that this proposal is economically reasonable, it is aware that detailed economic information is almost exclusively in the possession of aircraft manufacturers and operators. Thus, comments concerning the economic impacts of the

proposal are strongly encouraged and should be detailed and supported to the extent possible. In that connection, it should be emphasized that general or unsupported assertions as to the anticipated economic impact of this proposal will be given limited weight.

The rule proposed in this notice follows the principles suggested by several commenters for providing a simplified three-point measurement with representative flight path tests based on the operating and noise emission characteristics of the aircraft. The FAA also agrees with most commenters who recommended prescribing those noise rules separately from the provisions in Part 36 that apply to other specific regulatory classes of aircraft. However, the FAA does not agree that an entirely new part of the FARs is necessary to accomplish that delineation. The FAA believes that Part 36 can adequately accommodate additional rules for other classes of aircraft based on the general noise type certification concept embodied in the whole of Part 36. Accordingly, the FAA proposes to add a new Subpart H and related Appendix H to FAR Part 36 as the organizational basis for a helicopter noise type certification regulation. However, current provisions governing the measurement and evaluation of noise data in terms of EPNL do not depend on the class of aircraft to which they apply and, with certain substitutions, are proposed as part of the new Appendix H for helicopters. Necessary minor amendments to the FAR Part 21 certification procedures complement the Part 36 proposal.

F. Applicability Dates and Compliance Schedule

The FAA requested comments concerning the applicability and compliance dates that should be specified in a proposed noise regulation for the different subclasses of short-haul aircraft. One commenter felt that compliance with the noise rule should not be required for at least 12 months after publication of the notice of proposed rule making. Several commenters supported adoption of the principle underlying current Part 36 certification, where compliance is related to the date of application for certification or acoustical change approval. In that regard, several commenters suggested applying the standards immediately to all new applications made after a date related to certain regulatory events, such as upon publication of the NPRM or the final rule or after six or twelve months after the adoption of a final rule.

The FAA agrees with those commenters who recognized that a proposed rule for any subclass of short-haul aircraft should require compliance as soon as practicable in light of the factors which the FAA must consider under § 611 of the Act, including the extent to which the proposal contributes to carrying out the purposes of § 611. Based on its experience with noise type certification under Part 36, the FAA believes that the proposed noise regulation, like current Part 36, should require compliance based on the date of the application for type certification or acoustical change approval. Accordingly, the proposed helicopter noise standard would prescribe applicability and compliance consistent with similar requirements of Part 36 for other regulated classes of aircraft. Under the proposal, for applications for new type certificates, the applicability date is the publication date of this notice. For acoustical change approvals, that date would be the effective date of the final rule. For applications to which the proposed rule would apply, compliance would be required if the issuance or approval is made on or after the effective date of the final rule. For standard airworthiness certificates and restricted airworthiness certificates for newly produced helicopters (with no prior flight time), based on type designs certificated before the effective date of the final rule, compliance would be required on and after January 1, 1985, regardless of the date of application.

G. Utilization of Capabilities

In the ANPRM the FAA asked whether limitations could be expected on the actual use of the high maneuverability capabilities of short-haul aircraft due to certain operator practices based on passenger comfort, pilot acceptance, navigation equipment, safety margins, and operating economies. While few comments addressed this area of inquiry, those submitted indicated the possibility that some operator limitations on aircraft capability could occur. However, since those capabilities have not been fully defined and cannot be forecast with any degree of certainty, the matter should be the subject of further investigation before proceeding with future rule making.

The FAA agrees that the particular operational characteristics of these aircraft may differ considerably from those of conventional aircraft and, since conventional aircraft tend to provide the basis for acceptance of current operating techniques, there may be some reluctance to fully adopt and utilize the higher maneuvering capabilities of short-haul aircraft as they become part of future aircraft fleets. The FAA believes that further information will be needed to determine the extent to which any future rules should influence the demonstration and utilization of those characteristics in noise certification and actual operations. As the technology advances, it may become necessary to propose for adoption additional airworthiness and environmental rules. In developing the standards, the FAA would provide the opportunity for public comment on all aspects of the rule, including consideration for pilot workload, passenger comfort and acceptance, and specific flight trajectories and other maneuverability factors. This notice necessarily deals with those matters as they affect helicopter noise standards and comments are invited regarding them as they involve the proposed rule.

H. Enroute Altitudes or Noise Limits

The ANPRM requested comments concerning the need for a minimum enroute altitude or an enroute noise limit for short-haul aircraft based on attainable noise reductions by particular aircraft as they might be flown in in-service operations. Many of the commenters on this issue advanced the proposition that in the total noise abatement scheme for short-haul aircraft such regulatory features should be considered, particularly in developing rules oriented to the control of operational noise or certification rules which involve operating limitations. While specific comments have been duly considered, no decision on recommendations they contain has been made at this time in light of the determination not to propose noise certification rules for short-haul aircraft. The FAA believes that no need has been shown for establishing any enroute noise limit for any regulated class of aircraft. The FAA believes, that the proposed noise rules should be directed only to noise type certification and changes to type design of helicopters.

I. Economic Incentives

Another area of consideration on which comments were invited involved the extent to which economic incentives might be applied through FAA rule making to produce the maximum amount of noise reduction for short-haul aircraft.

Most commenters doubted that the FAA could properly provide direct economic benefits or impose economic penalties to encourage the early or complete application of noise

technology. Those commenters generally felt that the Part 36 noise type certification provides all the economic incentives needed to produce maximum noise reduction consistent with the requirements of § 611 of the Act. Some stated that the constraints of economic reasonableness precludes economic incentives as they are normally applied.

Upon review of the comments in light of its noise certification experience, the FAA agrees that the Part 36 approach to ensuring compliance and application of appropriate noise control technology provides adequate incentives without developing specific economic inducements apart from those inherent in the current rules and their enforcement. The proposal in this notice follows those principles.

J. EPNL as the Noise Descriptor

Effective Perceived Noise Level (EPNL) quantified in units of Effective Perceived Noise Decibles (EPNdB) is the noise descriptor adopted under FAR Part 36 for noise levels of transport category large airplanes and turbojet powered airplanes. In considering the need for proposing noise regulations for short-haul aircraft, the FAA requested comments regarding whether EPNL is the appropriate descriptive unit for noise type certificating the various subclasses of short-haul aircraft.

While most commenters addressed that issue, there was considerable divergence of opinion at that time on the appropriateness of EPNL. Some commenters favored adoption of the A weighted dB unit with necessary tonal and duration corrections. The dBA unit is used in many community noise measurements and is relatively simple and less expensive to apply. Some commenters favored EPNL in order to account for the complexities of aircraft noise characteristics and because it had been use with considerable acceptance for transport category large airplanes and turbojet powered airplanes under Part 36 since 1969. Some who were not particularly enthusiastic about EPNL supported its adoption on the basis of its being better than other known alternatives.

Due to the concerns raised by commenters responding to the ANPRM and a broader controversy that had been ensuing regarding which noise evaluation unit was best in quantifying the impacts of aircraft noise on the public health and welfare, the FAA undertook several studies on the subject. Also numerous independent investigations into aircraft noise descriptors were conducted, including studies by the U.S. Environmental Protection Agency.

A review of those studies and data available to the FAA insofar as they relate to the helicopter noise lead to the proposal to adopt EPNL under the helicopter noise regulation. The FAA believes that helicopter noise levels in units of EPNdB more closely reflect the psychoacoustic response to helicopter noise than any other current unit or adjustment. A more detailed discussion of the bases for that position is presented in the previous discussion on the background of the proposal and in the environmental assessment prepared in conjunction with this notice.

K. Alternative Approaches to the Problem.

In attempting to develop an appropriate proposed noise rule for short-haul aircraft, the FAA indicated its willingness to consider new, unexplored areas of additional study or alternative methods for regulating in a manner that is economically reasonable, technologically practicable and appropriate for the aircraft affected.

While most of the recommendations received from commenters involved matters previously discussed, some commenters recommended entirely different regulatory concepts from those suggested in the ANPRM or followed by current Part 36. Several commenters discussed the areas in which the current understanding of the short-haul noise reduction potential is minimal or totally lacking and which should be investigated before appropriate noise standards are developed. The areas recommended by one or more commenters for further study or experimental programs for short-haul aircraft include the following:

1. Propulsion systems.
2. Powered lift systems.
3. High-thrust approach and reverse-thrust noise.
4. Operating and noise emission characteristics.
5. Performance and airworthiness standards.
6. Operating economics.
7. Safe flight procedures, including passenger reaction to "unusual" rates of descent, altitude changes, or other maneuvers.
8. Special flight characteristics of subclasses of short-haul aircraft.
9. Adequate technical basis for noise measurement units that accurately account for the quantitative and qualitative sound pressure levels that produce annoyance or affect the public health and welfare.
10. Noise test methodologies, including measuring points, which result in measured noise data representative of the operating and noise emission characteristics of each regulated class or subclass of aircraft.
11. More accurate noise prediction methodologies.
12. Acoustic properties of existing architectural structures near airports that would serve the affected aircraft.
13. Ambient noise levels near those airports.

As discussed previously, the FAA agrees that additional information is needed before proceeding with separate rule making for short-haul aircraft other than helicopters.

Two commenters recommended that aircraft noise certification should be in terms of the size and location of land areas which are impacted by specific levels of noise (as depicted by "noise foot-print" or noise contour). One of the recommendations included certification of airports in terms of permitting aircraft operations consistent with noise contours not impacting any noise sensitive areas around the airport.

In developing aircraft noise certification standards, the FAA has considered concepts similar to those recommended by the commenters but selected the regulatory approach currently prescribed in FAR Part 36. (Airport noise certification, as recommended by the EPA, is being considered separately by the FAA and under Notice No. 76–24; 41 FR 1522; Nov. 22, 1976).

As stated in the preambles adopting Part 36 and various subsequent amendments, the FAA has prescribed standards that must be met by aircraft manufacturers for source noise abatement purposes as a condition to FAA certification or approval of their products. The current three-point noise measurement concept specified in Part 36 was adopted, in part, because it provides accurate and repeatable noise levels at each measuring point which can be compared to prescribed noise limits to show compliance. The conditions of noise measurement under Part 36 are intended to ensure that the noise values demonstrated during certification are reasonably representative of those produced in normal operations (and can be repeated) under relatively high power or thrust conditions. However, the standardized certification profile is not intended to prescribe conditions which govern the operation of aircraft at specific airports. Data acquired during noise certification and other specified testing programs are used in the FAA Integrated Noise Model

in describing and defining the impact of aircraft noise around an airport. Under the DOT/FAA Aviation Noise Abatement Policy, it is the airport proprietor who has the primary responsibility for ensuring that airport operations are compatible with the airport community. The integrated noise model was developed to assist the airport proprietors in fulfilling their responsibilities by providing a tool for assessing actual or predicted noise impacts (single and cumulative event contours) directly attributable to the airport operations decisions and their alternatives. Thus, airport proprietors through decisions regarding operations of their airports and the FAA through aircraft (source) noise certification requirements are jointly endeavoring to improve the quality of life of the public near airports. In addition, the FAA will continue to issue appropriate aircraft operating regulations (such as FAR Amendment 91–134, Noise Abatement Landing Flap Setting) to reduce aircraft operational noise, consistent with flight safety and § 611 of the Act.

L. International Standards

In response to Notice No. 73–32, several commenters encouraged the development of noise standards for short-haul aircraft on an international basis through the International Civil Aviation Organization (ICAO). Those commenters stressed that international uniformity in aircraft noise requirements is essential to avoid inconsistency among varying standards adopted by member States and, the potential for unjust economic advantages or disadvantages resulting from those differences.

The FAA agrees that international standards for aircraft noise are very desirable. As part of its commitment to resolving aircraft noise problems on the international level, the FAA continues to work with the ICAO Committee on Aircraft Noise and its various working groups in developing noise standards for various classes of aircraft. In that regard, the FAA is currently involved with the ICAO in its development of international noise standards for helicopters and will actively support the adoption of appropriate standards. The FAA notes that, while international uniformity is a desirable objective, its authority and responsibilities under § 611 of the Act require that it proceed with appropriate U.S. rule making regardless of the prospects for achieving that objective. Accordingly, while every effort will be made to secure adoption of international noise rules through the ICAO, the FAA should continue with U.S. rule making in accordance with the purposes and authority under the Act.

IX. Rule Structure

As part of its proposal, the FAA is considering a substantial reorganizing and restructuring of certain portions of current Part 36 without any change in their substance. In order to improve their usefulness and understandability, the FAA believes that the technical provisions governing the measurement and evaluation of aircraft noise test data under Appendixes A and B should contain only those matters that apply generally to all noise tests for all regulated classes of aircraft which employ EPNL as the quantifying unit. Those provisions which affect each particular regulated class should be prescribed separately in provisions that apply only to that class. In that way, the FAA believes that any potential confusion over which portions of Appendixes A and B apply in measuring and evaluating noise levels in terms of Effective Perceived Noise Levels (EPNL) would be eliminated since those provisions would apply generally unless otherwise expressly provided in those provisions applicable to the particular regulated class of aircraft.

Since Appendixes A and B currently apply only to one regulatory class, transport category large airplanes and turbojet powered airplanes under Subpart C of Part 36, the current regulation achieves that objective. However, if a proposed noise standard for helicopters or any future regulatory class is adopted, the technical specifications would apply to additional regulatory classes and, thus, the statement of regulation would become more complex. Accordingly, comments are specifically invited regarding whether those provisions should be restructured, and, if so, specifically how it should be done in order to improve the presentation and the statement of the rules while retaining their substantive content.

In order to indicate those substantive areas under the proposal which differ from the requirements of current Appendixes A and B (as applied to transport category large airplanes and turbojet powered airplanes), the proposed helicopter noise rule contained in this notice states that the provisions of Appendixes A and B apply, except as otherwise provided under proposed requirements that apply only to noise tests for helicopters. As an alternative to the proposed restructuring of the rules, the approach taken in this notice could be adopted if, after further consideration, the FAA concludes that it is the preferable way to present the rules. Thus, comments are invited on the organizational technique for accomplishing the goal of providing a useful and understandable rule. Suggestions on other means for improving the presentation and statement of the aircraft noise rules, which do not involve changes in the substance of those rules, are also welcomed.

The Proposed Amendment

Accordingly, the Federal Aviation Administration proposes to amend Parts 21 and 36 of the Federal Aviation Regulations (14 CFR Parts 21 and 36) as follows:

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

1. By amending § 21.93(b) as follows:

a. By deleting the word "airplane" wherever it appears in the introductory clause and substituting for it the word "aircraft."

b. By adding a new paragraph (b)(4) to read as follows:

§ 21.93 Classification of changes in type design.

* * * * *

(b) * * *

(4) Helicopters, as defined under Part 36 of this chapter, in the normal, transport, and restricted categories. For helicopters to which this paragraph applies, "acoustical changes" include the following type design changes:

(i) Any change to, or removal of, a muffler or other component designed for noise control.

(ii) Any design change which results in an increase in—

(A) The maximum rotor tip speed;

(B) The maximum continuous power;

(C) The takeoff power; or

(D) The maximum takeoff weight of the helicopter.

(iii) Any other design change that the Administrator determines might result in increased noise levels of that helicopter.

§ 21.115 [Amended]

2. By amending § 21.115 at the end of paragraph (a) by deleting the words "§ 36.7 of this chapter" and substituting for them the words "§§ 36.7, 36.9, or 36.11 of this chapter."

3. By amending § 21.183 by deleting the last sentences in paragraphs (e)(1) and (2) and by adding new paragraphs (e)(3) and (4) to read as follows:

§ 21.183 Issue of standard airworthiness certificates for normal, utility, acrobatic, and transport category aircraft.

* * * * *

(e) * * *

(3) For normal and transport category helicopters, as defined under Part 36 of this chapter, that have not had any flight time before the date specified in Part 36 of this chapter, no standard airworthiness certificate is originally issued under this section unless the applicant shows that the type design complies with the applicable noise requirements of Part 36 of this chapter in addition to the applicable airworthiness requirements in this section.

(4) For import aircraft, compliance with this paragraph is shown if—

(i) Compliance is shown with the requirements of paragraph (c) of this section; and

(ii) Either—

(A) The country in which the aircraft was manufactured certifies, and the Administrator finds, that the applicable requirements of Part 36 of this chapter have been complied with; or

(B) Compliance is shown with the applicable aircraft noise requirements of the country in which the aircraft was manufactured and with any additional requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with the applicable requirements of Part 36 of this chapter.

4. By amending paragraph (d) of § 21.185 by designating the first sentence as paragraph (d)(1), by deleting the second sentence, and by adding new paragraphs (d)(2) and (3) to read as follows:

§ 21.185 Issue of airworthiness certificates for restricted category aircraft.

* * * * *

(d) * * *

(2) For helicopters, as defined under Part 36 of this chapter, that have not had any flight time before the applicable date specified in Part 36 of this chapter, and notwithstanding the other provision of this section, no original restricted category airworthiness certificate is issued under this section unless the applicant shows that the type design complies with the applicable noise requirements of Part 36 of this chapter in addition to the applicable airworthiness requirements of this section.

(3) For import aircraft, compliance with this paragraph is shown if—

(i) Compliance is shown with the requirements of paragraph (c) of this section; and

(ii) Either—

(A) The country in which the aircraft was manufactured certifies, and the Administrator finds, that the applicable requirements of Part 36 of this chapter have been complied with; or

(B) Compliance is shown with the applicable aircraft noise requirements of the country in which the aircraft was manufactured and with any requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with the applicable requirements of Part 36 of this chapter.

PART 36—NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

5. By amending § 36.1 as follows:

§ 36.1 Applicability and definition. [Amended]

a. By adding a new paragraph (a)(4) to read as follows:

(a) * * *

(4) Type certificates, and changes to those certificates, and standard airworthiness certificates and restricted category airworthiness certificates, for helicopters, as defined under paragraph (h) of this section.

* * * * *

b. By amending paragraph (c)—

(1) By deleting the word "airplane" and substituting for it the word "aircraft"; and

(2) By deleting the words "the applicable provisions of § 36.7 or § 36.9 of this part" and substituting for them the words "the applicable provisions of §§ 36.7, 36.9, or 36.11 of this part."

c. By adding new paragraphs (g) and (h) to read as follows:

* * * * *

(g) Each person who applies for the original issue of a standard airworthiness certificate under § 21.183 or of a restricted category airworthiness certificate under § 21.185 of this chapter, for a helicopter, as defined under paragraph (h) of this section, that has not had any flight time before January 1, 1985, must show compliance with the applicable provisions of this part (including Appendix H).

(h) For the purpose of showing compliance with this part, for helicopters in the normal, transport, and restricted categories, the following terms have the specified meanings:

(1) "Helicopters" include other aircraft, except gyroplanes, for which lift is furnished, in whole or part, by an engine-driven rotor during takeoff, hover, or landing.

(2) A "Stage 1 noise level" means a takeoff, flyover, or approach noise level greater than the Stage 2 noise limits prescribed in § H36.305 of Appendix H of this part.

(3) A "Stage 1 helicopter" means a helicopter that has not been shown under this part to comply with the takeoff, flyover, and approach noise levels required for Stage 2 helicopters.

(4) A "Stage 2 noise level" means a takeoff, flyover, or approach noise level at or below the Stage 2 noise limits prescribed in § H36.305(a)(2) of Appendix H of this part.

(5) A "Stage 2 helicopter" means a helicopter that has been shown under this part to comply with Stage 2 noise levels prescribed in § H36.305 of Appendix H of this part.

6. By amending §§ 36.2 and 36.3 by deleting the word "airplane" wherever it appears and substituting for it the word "aircraft".

7. By amending subpart A by adding a new § 36.11 to read as follows:

§ 36.11 Acoustical change: Helicopters.

This section applies to all helicopters in the normal, transport, and restricted categories for which an acoustical change approval is applied for under § 21.93(b) of this chapter on and after (effective date of the final rule).

(a) *General requirements.* Except as otherwise provided, for helicopters covered by this section, the acoustical change approval requirements are as follows:

(1) In showing compliance, noise levels must be measured, evaluated, and calculated in accordance with the applicable procedures and conditions prescribed in Parts B and C of Appendix H of this part.

(2) Compliance with the noise limits prescribed in § H36.305 of Appendix H must be shown in accordance with the applicable provisions of Part D of Appendix H of this part.

(b) *Stage 1 helicopters.* For each Stage 1 helicopter prior to the change in type design, the helicopter may not, after the change in type design, exceed the noise levels created prior to the change in type design. The tradeoff provisions under § H36.305(b) may not be used to increase any Stage 1 noise level.

(c) *Stage 2 helicopters.* For each Stage 2 helicopter prior to the change in type design, the helicopter must be a Stage 2 helicopter after the change in type design.

Subpart G [Redesignated as Subpart O] Subparts G, I, J, K, L, M, and N [Reserved]

8. By redesignating Subpart G as "Subpart O.—Operating Limitations and

Information" and marking Subparts: G, I, J, K, L, M, and N as "[Reserved]".

§ 36.1581 [Amended]

9. By amending § 36.1581 as follows:

a. By amending paragraph (a) after the words "Airplane Flight Manual" in each place where those words appear by adding the words "or Rotorcraft Flight Manual."

b. By amending paragraph (b) in the prescribed statement by deleting the word "airplane" and substituting for it the word "aircraft."

c. By redesignating paragraph (e) as "paragraph (f)" and amending it to read as follows:

* * * * *

(f) Except as provided in paragraph (c), (d), and (e) of this section, no operating limitations are furnished under this part.

* * * * *

d. By adding a new paragraph (e) to read as follows:

* * * * *

(e) For normal, transport, and restricted category helicopters for which the weight used in meeting the take-off, flyover, or approach noise requirements of this part is less than the appropriate maximum weight or design landing weight, established under the applicable airworthiness requirements, that lesser weight must be furnished, as an operating limitation, in the operating limitations section of the Rotorcraft Flight Manual, in approved manual material, or on an approved placard.

* * * * *

10. By adding a new Subpart H to read as follows:

Subpart H—Helicopters

Sec.

36.801 Noise measurement.
36.803 Noise evaluation and calculation.
36.805 Noise limits.

Authority: Secs. 313(a), 601(a), 603, and 611(b), Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421(a), 1423, and 1431(b)); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*); Executive Order 11514, March 5, 1970, and 14 CFR 11.45.

Subpart H—Helicopters

§ 36.801 Noise measurement.

For normal, transport, and restricted category helicopters, the noise generated by the helicopter must be measured under Part B of Appendix H of this part or under an FAA-approved equivalent procedure.

§ 36.803 Noise evaluation and calculation.

The noise measurement data obtained under § 36.801 must be evaluated and calculated under Part C of Appendix H of this part or an FAA-approved equivalent procedure.

§ 36.805 Noise limits.

(a) Compliance with this subpart must be shown and demonstrated at the noise measuring points and under the test conditions prescribed under Part D of Appendix H of this part as follows:

(1) For helicopters for which application for issuance of a type certificate in the normal, transport, or restricted category is made on or after [the publication date of this notice].

(2) For helicopters for which application is made for the original issue of a standard airworthiness certificate or of a restricted category airworthiness certificate and that have not had any flight time before January 1, 1985 (regardless of the date of application).

(b) For helicopters covered by this section, it must be shown, in accordance with this subpart, that the noise levels of the helicopter are no greater than the applicable limits prescribed under § H36.305 of Appendix H of this part.

§ 1336.1 [Amended]

11. By amending § B36.1 at the end of the first sentence by deleting the words "under § 36.103" and substituting for them the words "under §§ 36.103 and 36.803."

12. By adding a new Appendix H to read as follows:

Appendix H—Noise Requirements for Helicopters Under Subpart H

Sec.

PART A—GENERAL
H36.1 Scope.
PART B—NOISE MEASUREMENT UNDER § 36.801
H36.101 Noise certification and measurement conditions.
H36.103 Measurement of aircraft noise received on the ground.
H36.105 Reporting and correcting measured data.
H36.107 Symbols and units.
H36.109 Atmospheric attenuation of sound.
H36.111 Detailed data correction procedures.
PART C—NOISE EVALUATION AND CALCULATION UNDER § 36.803
H36.201 Evaluation of measured noise values.
H36.203 Calculation of noise levels.
PART D—NOISE LIMITS UNDER § 36.805
H36.301 Noise measurement, evaluation, and calculation.
H36.303 Noise measuring points.
H36.305 Noise levels.
H36.307 Takeoff test conditions.
H36.309 Flyover test conditions.
H36.3011 Approach test conditions.

Appendix H—Noise Requirements for Helicopters Under Subpart H

Part A—General

§ H36.1 *Scope.* This appendix prescribes noise requirements for helicopters specified under § 36.1, including—

(a) The conditions under which helicopter noise certification tests under Subpart H must be conducted and the measurement procedures that must be used under § 36.801 to measure helicopter noise during each test;

(b) The procedures which must be used under § 36.803 to evaluate the measured noise data and to calculate the noise evaluation quantity designated as Effective Perceived Noise Level (EPNL); and

(c) The noise limits for which compliance must be shown under § 36.805 at the prescribed noise measuring points under the prescribed test conditions.

PART B—NOISE MEASUREMENT UNDER §36.801

§ H36.101 *Noise certification test and measurement conditions.*

(a)(1) Except as provided in paragraph (a)(2) of this section, the provisions of § A36.1 of Appendix A of Part 36 apply to helicopter noise certification tests conducted under this appendix. Section A36.1 includes requirements governing—

(i) Test site requirements;

(ii) Weather restrictions; and

(iii) Aircraft test procedures.

(2) Notwithstanding the provisions of § A36.1 of Appendix A to the contrary, the following apply to helicopter noise certification tests:

(i) The test site requirements of paragraph (b) of this section apply to helicopter noise tests in lieu of the provisions under paragraph (b) of § A36.1 of Appendix A.

(ii) The airport reported wind conditions under paragraph A36.1(c)(4) may not exceed 10 knots and the direction must be within 15 degrees of the reference flight track.

(iii) The takeoff and approach testing procedure requirements of paragraph A36.1(d) apply to the takeoff, and approach noise tests for helicopters, respectively. The requirements of paragraph A36.1(d)(5) also apply to fly over noise tests. Notwithstanding provisions to the contrary, the helicopter height and lateral position is relative to the centerline of the reference flight track (which passes through the noise measuring point) rather than the runway.

(iv) The approach angle under paragraph A36.1(d)(6) is $6.0° \pm 0.5°$.

(v) Each takeoff test must comply with the provisions under § H36.305 of this appendix.

(vi) Each fly-over test must comply with the provisions under § H36.307 of this appendix.

(vii) Each approach test must comply with the provisions under § H36.309 of this appendix.

(b) *Helicopter test site requirements.* (1) Tests to show compliance with established helicopter noise certification levels must consist of a series of takeoffs, flyovers, and

approaches during which measurements must be taken at noise measuring stations located at the measuring points prescribed in § H36.301 of this appendix.

(2) Each takeoff test, flyover test, and approach test includes simultaneous measurements at the flight-track noise measuring station vertically below the reference flight path and as two sideline noise measuring stations, one on each side of the reference flight track.

(3) If the height of the ground at either sideline noise measuring station differs from that of the flight-track noise measuring station by more than 20 feet, as prescribed under § H36.105 of this appendix, corrections must be made in accordance with §A36.5(d) of Appendix A.

(4) Each noise measuring station must be surrounded by relatively flat terrain having no excessive sound absoption characteristics, such as might be caused by thick, matted, or tall grass, shrubs, or wooded areas.

(5) The location of an airport tower, or other facility, used to obtain required measurements of meteorological conditions at the test site, as prescribed under § H36.109 of this appendix, must be approved in accordance with § A36.9(b)(1) of Appendix A.

(6) During the period when the takeoff, flyover, or approach noise/time record indicates the noise measurement is within 10 dB of PNLTM, no obstruction that significantly influences the sound field from the aircraft may exist—

(i) For any flight-track or sideline noise measuring station, within a conical space above the measuring position (the point on the ground vertically below the microphone), the cone being defined by an axis normal to the ground and by a half-angle 80° from this axis; and

(ii) For any sideline noise measuring station, above the line of sight between the microphone and the helicopter.

§ H36.103 *Measurement of helicopter noise received on the ground.* The measurement of helicopter noise received on the ground during helicopter noise certification tests under this appendix must be accomplished in accordance with the provisions of § A36.3 of Appendix A of Part 36. Section A36.3 includes requirements governing—

(a) Measurements which provide the data for determining the one-third octave band noise produced by aircraft during testing at specific noise measuring stations, as a function of time;

(b) Sound pressure level data for aircraft noise certification purposes which must be obtained with approved acoustical equipment and measurement practices.

(c) Equipment specifications and the calibration and measurement procedures which apply to each certification test series.

§ H36.105 *Reporting and correcting measured data.* (a) Except as provided in paragraph (b) of this section, the provisions of § A36.5 of Appendix A of Part 36 apply to helicopter noise certification tests under this appendix. Section A36.5 includes requirements governing—

(1) Recording and reporting measured data, including certain physical measurements, corrections, equipment, and estimates;

(2) Reference conditions, including meteorological and aircraft conditions; and

(3) Corrections of measured data and test conditions.

(b) Notwithstanding the provisions of § A36.5 of Appendix A to the contrary, the following apply to helicopter noise certification tests:

(1) The reference approach angle under paragraph A36.5(c)(2)(ii) is 6°.

(2) The provisions of paragraph A36.5(e)(1), regarding validity of test results within the 90 percent confidence limits and each EPNL value, apply separately to each takeoff test series, fly-over test series, and approach test series, rather than at the takeoff, approach, and sideline noise measuring stations.

(3) As prescribed under §§ H36.305(b), H36.307(b) and H36.309(b), the minimum acceptable sample size of the certification measurements described in paragraph A36.5(e)(2) applies to each noise measuring station (six measurements at each flight-track and sideline noise measuring station).

§ H36.107 *Symbols and units.* (a) Except as provided in paragraph (b) of this section, the symbols and units described in § A36.7 of Appendix A of Part 36 apply to this appendix.

(b) Notwithstanding the meanings to the contrary prescribed in § A36.7, for helicopter noise certification, the following symbols and units as used in this appendix have the following meanings—

Flight Profile Identification Positions

Position	Description
A	Location of the noise measuring point at the flight-track noise measuring station vertically below the reference (takeoff, flyover, or approach) flight path.
B(1), (2)	Locations of the sideline noise measuring stations (not on flight track).
C	Start of noise certification takeoff flight path.
C_c	Start of noise certification corrected takeoff flight path.
D	Start of noise certification flyover flight path.
D_r	Start of noise certification reference flyover flight path.
E	Start of noise certification approach flight path.
E_r	Start of noise certification reference approach flight path.
F	Position on takeoff flight path directly above noise measuring station A.
G	Position on flyover flight path directly above noise measuring station A.
H	Position on approach flight path directly above noise measuring station A.
I	End of noise type certification takeoff flight path.
I_c	End of noise type certification corrected takeoff flight path.
J	End of noise type certification flyover flight path.
J_r	End of noise type certification reference flyover flight path.
K	End of noise type certification approach flight path.
K_r	End of noise type certification reference approach flight path.
L	Position on measured takeoff flight path corresponding to PNLTM at station A.
L_c	Position on corrected takeoff flight path corresponding to PNLTM at station A.
M	Position on measured flyover flight path corresponding to PNLTM of station A.
M_r	Position on reference flyover flight path corresponding to PNLTM of station A.
N	Position on measured approach flight measured flight path corresponding to PNLTM at station A.

Flight Profile Identification Positions—Continued

Position	Description
N_r	Position on reference approach flight path corresponding to PNLTM at station A.
P_a	Start of noise type certification approach flight track.
P_f	Start of noise type certification flyover flight track.
P_t	Start of noise type certification takeoff flight track.
R_a	End of noise type certification approach flight track.
R_f	End of noise type certification flyover flight track.
R_t	End of noise type certification takeoff flight track.
S	Position on measured approach path nearest to station A.
S_r	Position on reference approach path nearest to station A.
T	Position on measured takeoff path nearest to station A.
T_r	Position on reference takeoff path nearest to station A.

Distance	Unit	Meaning
AF	Feet	*Takeoff Height.* The vertical distance between the helicopter and station A.
AG	Feet	*Flyover Height.* The vertical distance between the helicopter and station A.
AH	Feet	*Approach Height.* The vertical distance between the helicopter and station A.
AL	Feet	*Measured Takeoff Noise Path.* The distance from station A to the measured helicopter position L.
AL_c	Feet	*Corrected Takeoff Noise Path.* The distance from station A to the corrected helicopter position L_c.
AM	Feet	*Measured Flyover Noise Path.* The distance from station A to the measured helicopter position M.
AM_r	Feet	*Reference Flyover Noise Path.* The distance from station A to helicopter position M_r on the reference flyover flight path.
AN	Feet	*Measured Apoproach Noise Path.* The distance from station A to the measured helicopter position N.
AN_r	Feet	*Reference Approach Noise Path.* The distance from station A to the reference helicopter position N_r.
AS	Feet	*Measured Approach Minimum Distance.* The distance from station A to the position S on the measured approach flight path.
AS_r	Feet	*Reference Approach Minimal Distance.* The distance from station A to the position S_r on the reference approach flight path.
AT	Feet	*Measured Takeoff Minimum Distance.* The distance from station A to the position T on the measured takeoff flight path.
AT_c	Feet	*Corrected Takeoff Minimum Distance.* The distance from Station A to the position T_c on the corrected takeoff flight path.
CI	Feet	*Takeoff Flight Path Distance.* The distance from position C at which the helicopter establishes a constant climb angle on the takeoff flight path passing over Station A and continuing to position I at which the position of the helicopter need no longer be recorded.
DJ	Feet	*Flyover Flight Path Distance.* The distance from position D at which the rotorcraft is established on the flyover flight path passing over Station A and continuing to position J at which the position of the helicopter need no longer be recorded.

Distance	Unit	Meaning
EK	Feet	*Approach Flight Path Distance.* The distance from position E at which the helicopter establishes a constant angle on the approach flight path passing over Station A and continuing to position K at which the position of the helicopter need no longer be recorded.

§ H36.109 *Atmospheric attenuation of sound.* The measured values of the one-third octave band spectra provided during helicopter nose certification tests under this appendix must conform, or be corrected, to the prescribed reference-day conditions in accordance with the provisions of § A36.9 of Appendix A of Part 36. Section A36.9 includes requirements governing—

(a) Correction of measured noise values to conform to reference-day conditions:

(b) Meteorological conditions at the noise measuring stations;

(c) Standards for sound attenuation rates; and

(d) Correction of noise values to account for sound attenuation rates.

§ H36.111 *Detailed correction procedures.* (a) *General.* If the test conditions do not conform to those prescribed as noise certification reference conditions under § H36.105 of this appendix, the correction procedures and requirements prescribed under § A36.11(a) of Appendix A of Part 36 apply. Section A36.11(a) includes requirements governing the correction procedures and standards for positive and negative values resulting from any differences between reference and test conditions.

(b) *Takeoff profile.* (1) Figure H1 illustrates a typical takeoff profile.

(i) The helicopter approaches position C in level flight at 65.6 feet above ground level at the flight-track noise measuring station and at either $V_y \pm 3$ knots or the maximum speed of the curve contiguous to the ordinate of the limiting height-speed envelope plus 3.0 knots (± 3.0 knots), whichever speed is greater. At position C, the helicopter initiates a constant climb at an angle β, crossing over station A at position F and continuing at the constant climb angle to the end of the noise type certification takeoff flight path represented by position I. The position of the helicopter should be recorded for a sufficient distance (CI) to ensure recording of the entire interval during which the measured helicopter noise level is within 10 dB of PNLTM, as required. Station A is the flight-track nosie measuring station from which the distance to position P_t is prescribed as 1650 feet. Positions $B_{(1)}$ $B_{(2)}$ are the respective sideline noise measuring stations located on each side of the flight track 492 feet from, and on a line perpendicular to, the flight-track at the noise measuring station (station A).

(ii) The takeoff parameters are functions of the helicopter performance and weight and the atmospheric conditions of temperature, pressure, and wind velocity and direction.

(2) Figure H2 illustrates comparative takeoff profiles when test conditions do not conform to prescribed reference conditions. The profile parameter differences may be derived from the manufacturer's data (approved by the FAA) and may be used to define the flight profile corrected to the reference conditions. The relationships between the measured and corrected takeoff flight profiles can then be used to determine the corrections, which, if positive, must be applied to the EPNL calculated from the measured data.

(3) Figure H3 illustrates the measured and corrected takeoff flight paths including the significant geometrical relationships influencing sound propagation. Position L represents the helicopter location on the measured takeoff flight path for which PNLTM is observed at station A, and L_c is the corresponding position on the corrected flight path. The measured and corrected sound propagation paths are AL and AL_c, respectively, which form angle ϕ with their flight paths. Position T represents the point on the measured takeoff flight path nearest station A, and T_c is the corresponding position on the corrected flight path. The minimum distance to the measured and corrected flight paths are indicated by the lines AT and AT_c respectively, which are normal to their flight paths.

BILLING CODE 4910-13-M

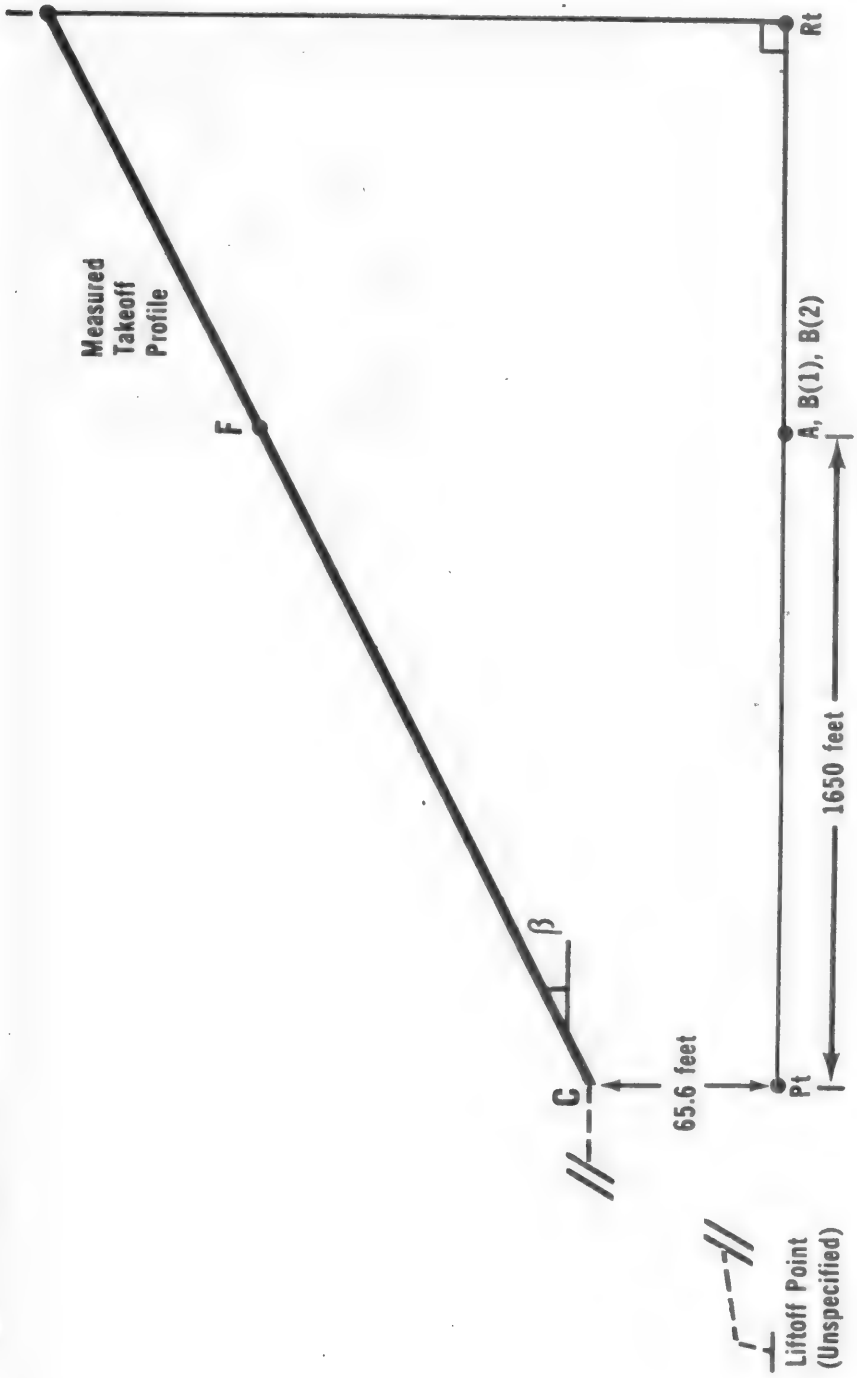

Figure H1. MEASURED TAKEOFF PROFILE

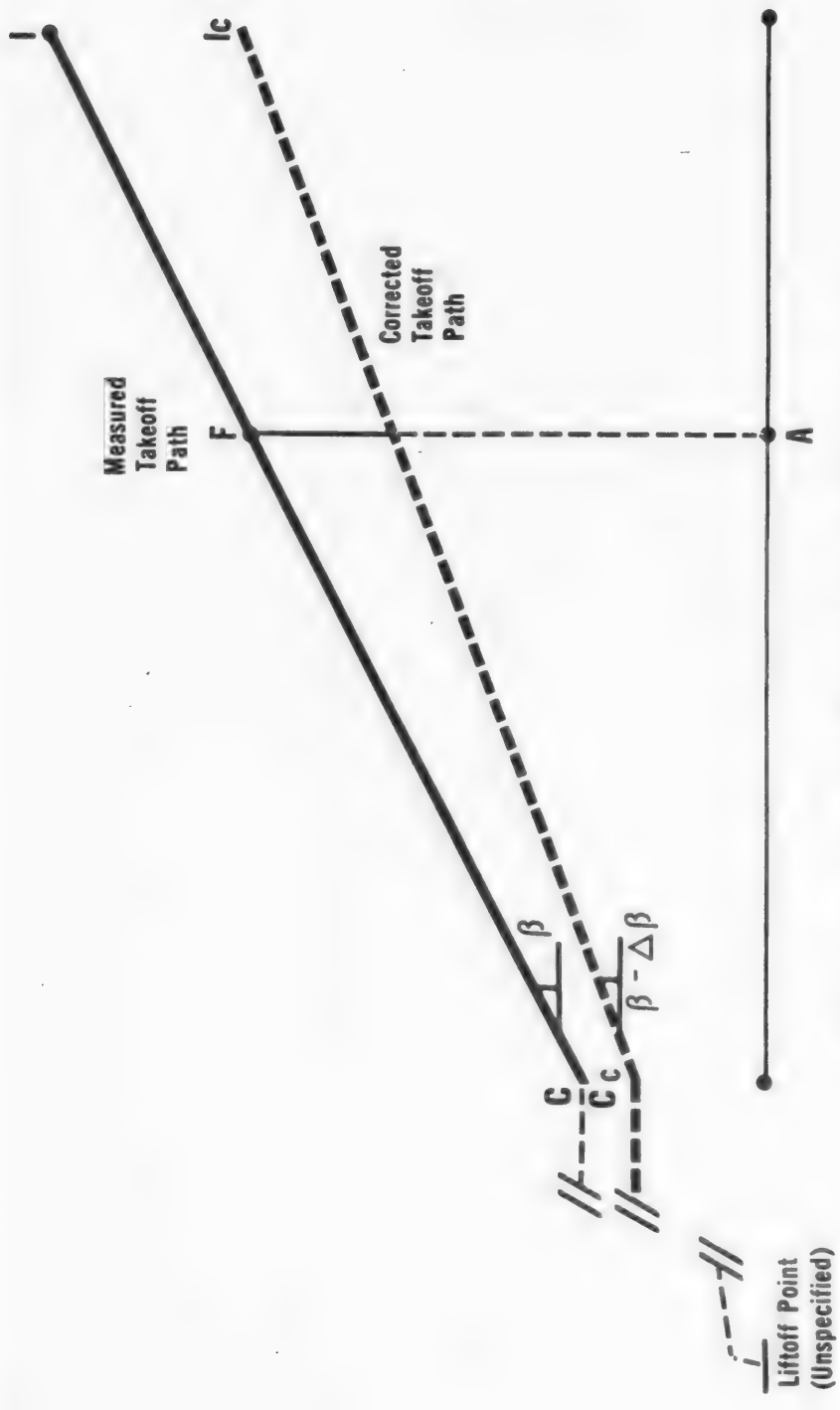

Figure H2. COMPARISON OF MEASURED AND CORRECTED TAKEOFF PROFILES

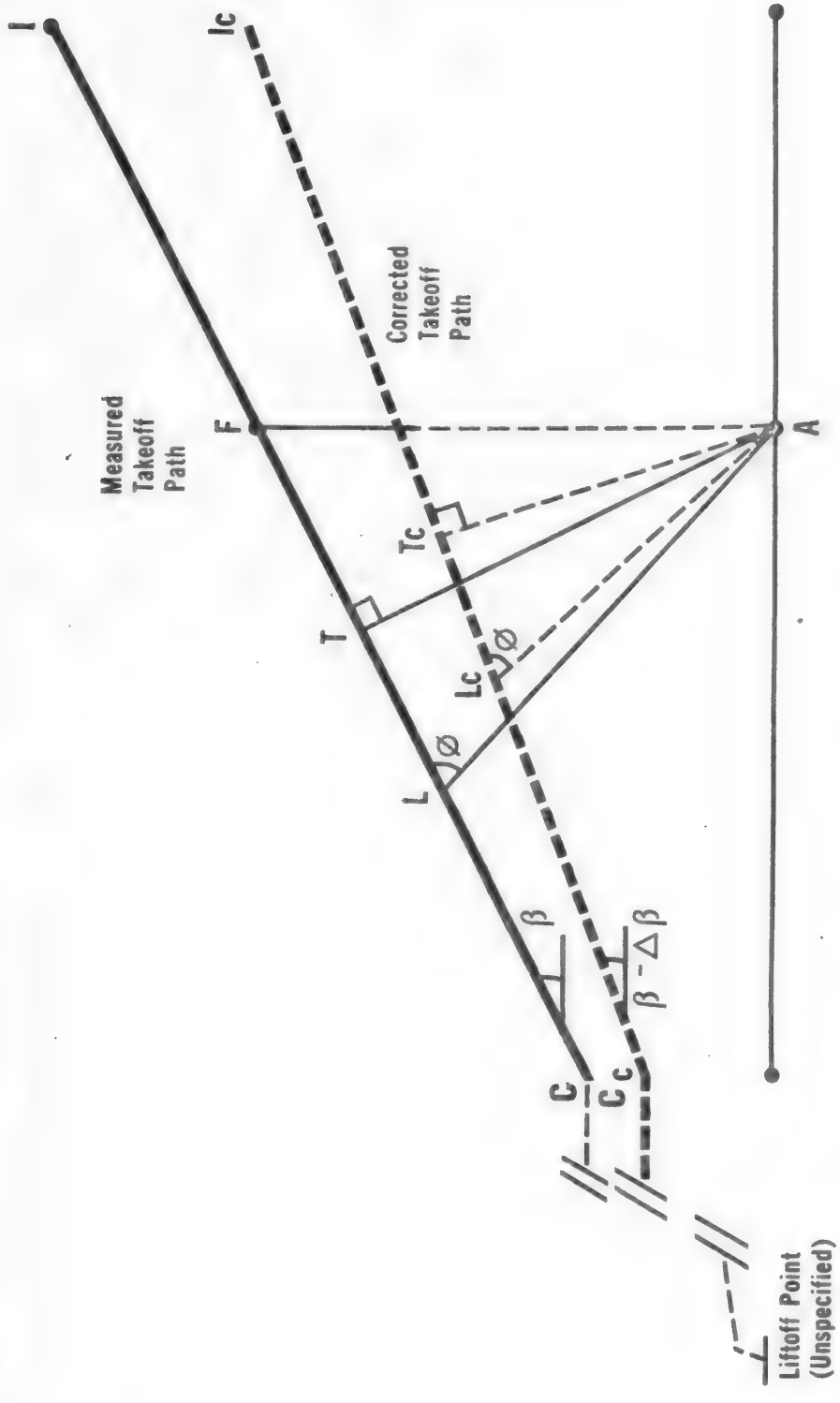

Figure H3. TAKEOFF PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

BILLING CODE 4910-13-C

(b) *Flyover profiles.* (1) The beginning of the noise type certification level flyover profile is represented by helicopter position D whose vertical projection on the flight track is position P_f (See Figure H4). The helicopter approaches position D in level flight 492 feet above ground level at station A. Speed is stabilized at either 90 percent V_H (maximum speed in level flight with maximum continuous power) or 90 percent V_{NE} (never exceed speed), whichever speed is lesser. Rotor speed is stabilized at maximum (top of the green arc) normal operating RPM. The helicopter crosses station A in level flight and proceeds to position J whose vertical projection on the flight track is position R_f. If the test requirements are otherwise met, flight direction may be reversed for each subsequent flyover, to obtain three test runs in each direction.

(2) Figure H5 illustrates comparative flyover profiles when test conditions do not conform to prescribed reference conditions. The position of the helicopter should be recorded for a sufficient distance (DJ) to endure recording of the entire interval during which the measured helicopter noise level is within 10 dB of PNLTM, as required. The flyover profile is defined by the height AG which is a function of the operating conditions controlled by the pilot. Position M represents the helicopter location on the measured flyover flight path for which PNLTM is observed at station A, and M_r is the corresponding position on the reference flight path. If the measured flyover profile conditions are different from the corresponding reference flyover conditions (492 feet and within 5° from the zenith at station A), corrections, if positive, must be applied to the EPNL calculated from the measured data.

BILLING CODE 4910-13-M

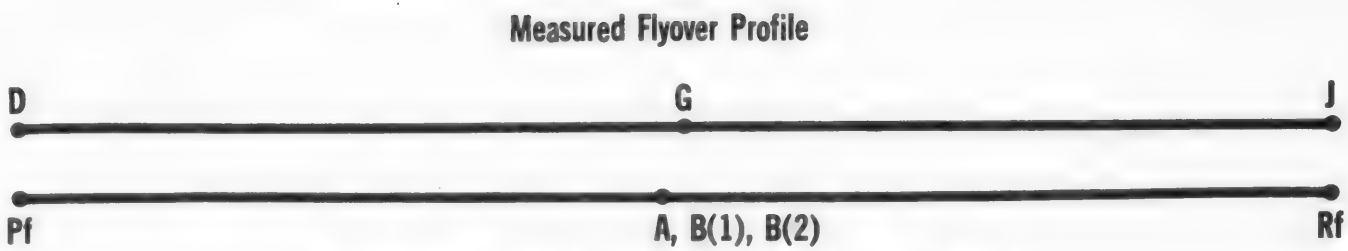

Figure H4. MEASURED FLYOVER PROFILE

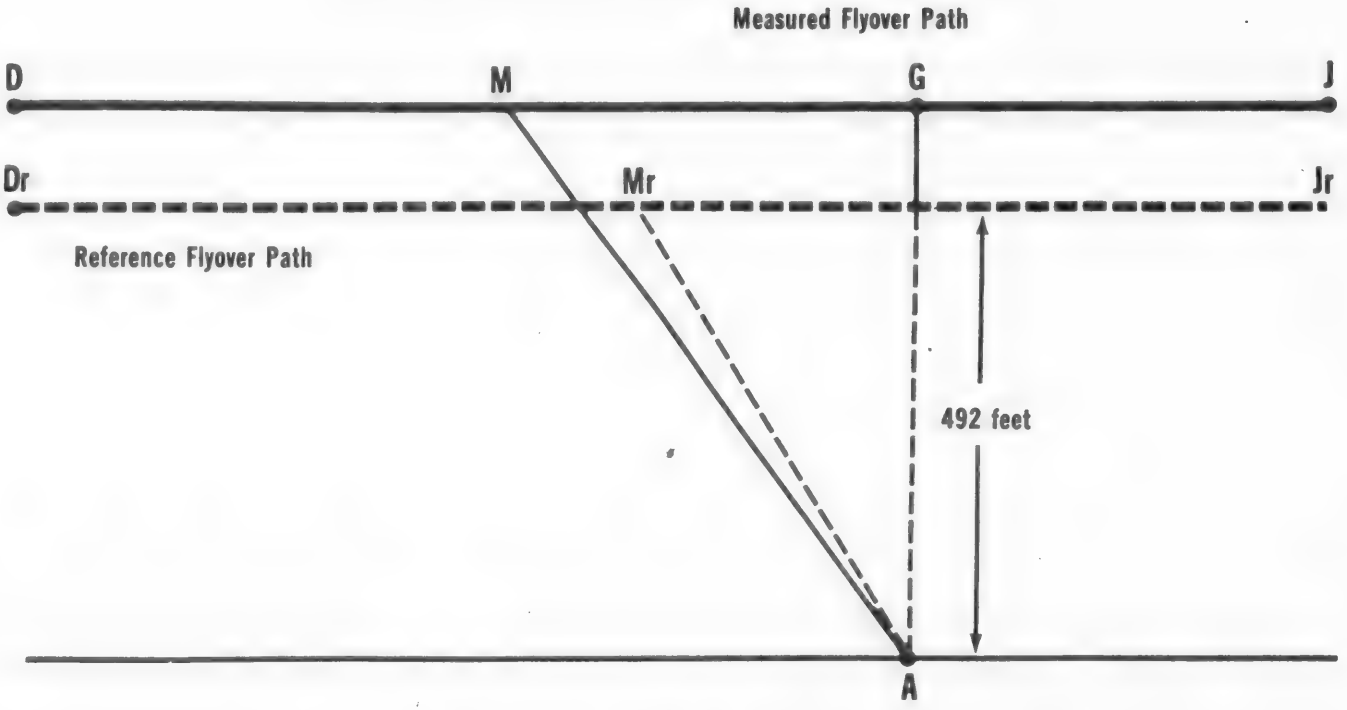

Figure H5. COMPARISON OF MEASURED AND CORRECTED FLYOVER PROFILES

BILLING CODE 4910-13-C

(c) *Approach profiles.* (1) Figure H6 illustrates a typical approach profile.

(i) The beginning of the noise type certification approach profile is represented by helicopter position E whose vertical projection on the flight track is position P_e. Position R_e is the vertical projection of position K on the flight track. The position of the helicopter should be recorded for a sufficient distance (EK) to ensure recording of the entire interval during which the measured helicopter noise level is within 10 dB of PNLTM, as required.

(ii) The helicopter approaches at angle η, passes directly over the station A at a height of AH, begins the level off at position K, which terminates the approach noise certification profile.

(iii) The approach profile is defined by the approach angle η, and the height AH which are functions of the helicopter operating conditions controlled by the pilot. If the measured approach profile conditions are different from the corresponding reference approach conditions (6° and 394 feet, respectively, as shown in Figure H7), corrections, if positive, must be applied to the EPNL calculated from the measured data.

(2) Figure H7 illustrates comparative approach profile when test conditions do not conform to prescribed reference conditions. The helicopter approaches position H on a 6° (±0.5°) approach slope. Speed is stabilized at either V_y (speed for best rate of climb ±3 knots, or the maximum speed of the curve contiguous to the ordinate of the limiting height-speed envelope plus 3.0 knots (±3.0 knots), whichever speed is greater. Rotor speed is stabilized at maximum (top of the green arc) normal operating RPM. The helicopter crosses position E and proceeds along the approach slope crossing over station A while maintaining the prescribed stabilized speed and rotor RPM. The helicopter continues the approach until it reaches position K.

(3) Figure H8 illustrates portions of the measured and reference approach flight paths including the significant geometrical relationships influencing sound propogation. EK represents the measured approach path with approach angle η, and E_rK_r represents the reference approach path at lower altitude and approach angle of 6°. Position N represents the helicopter location on the measured approach path for which PNLTM is observed at station A, and N_r is the corresponding position on the reference approach flight path. The measured and corrected noise propagation paths are AN and AN_r, respectively, which form the same angle λ with their flight paths. Position S represents the point on the measured approach flight path nearest station A, and S_r is the corresponding point on the reference approach flight path. The minimum distances to the measured and reference flight paths are indicated by the lines AS and AS_r, respectively, which are normal to their flight paths.

Note.—The reference approach fight path is defined by angle η (6°) and AH (394 feet). Consequently, AS_r can also be defined (AS_r=393 feet, to the nearest foot) and is, therefore, considered to be one of the reference parameters.

BILLING CODE 4910-13-M

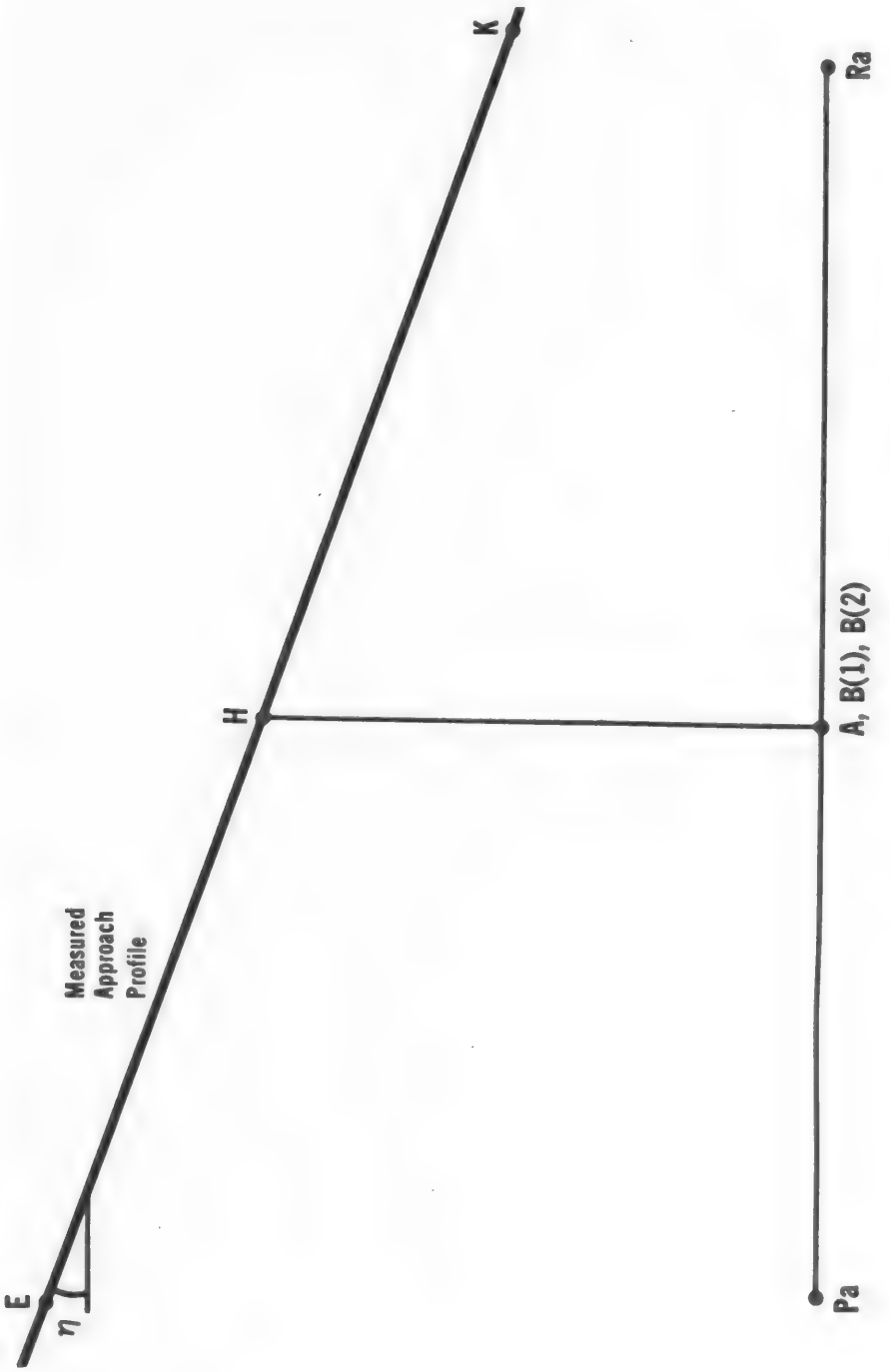

Figure H6. MEASURED APPROACH PROFILE

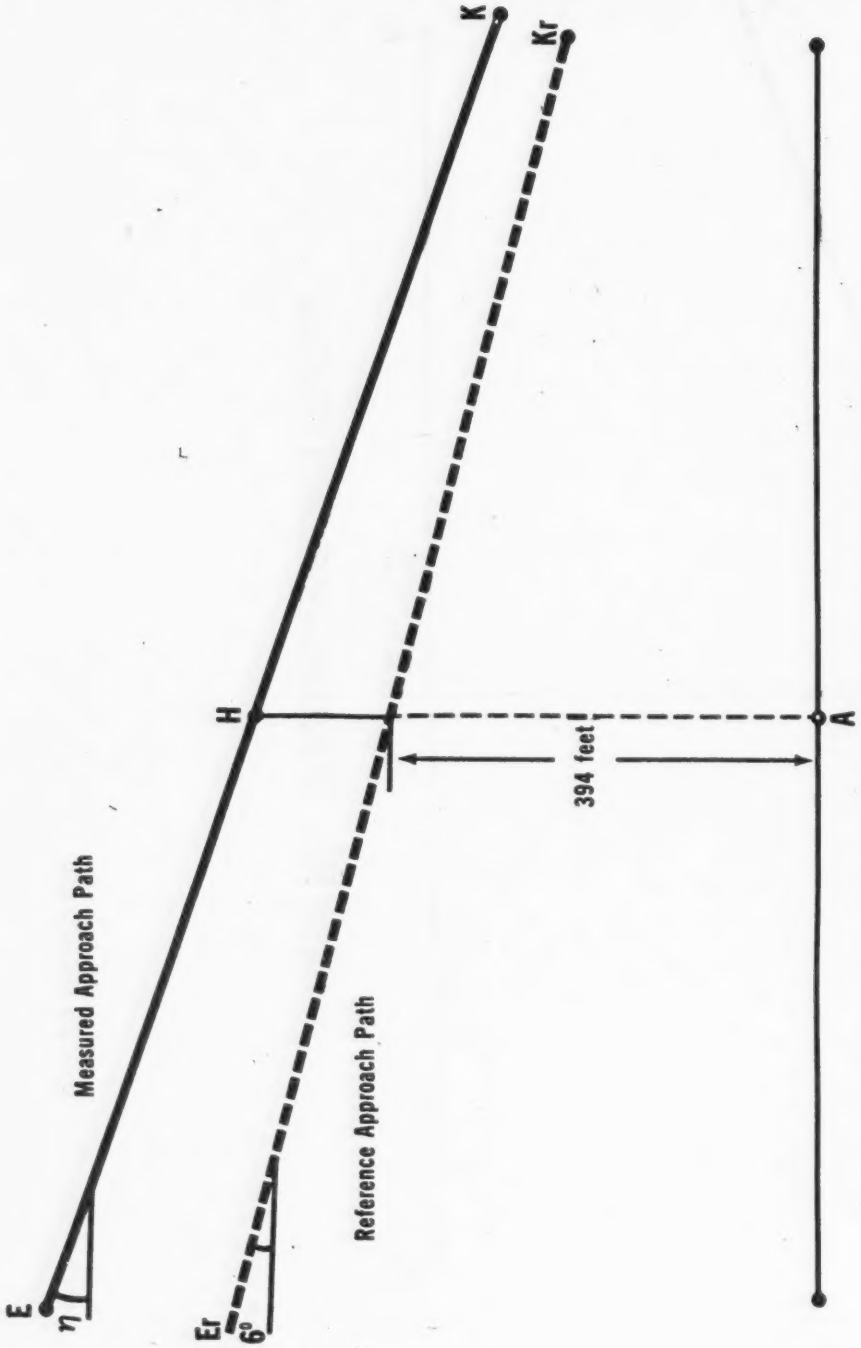

Figure H7. COMPARISON OF MEASURED AND CORRECTED APPROACH PROFILES

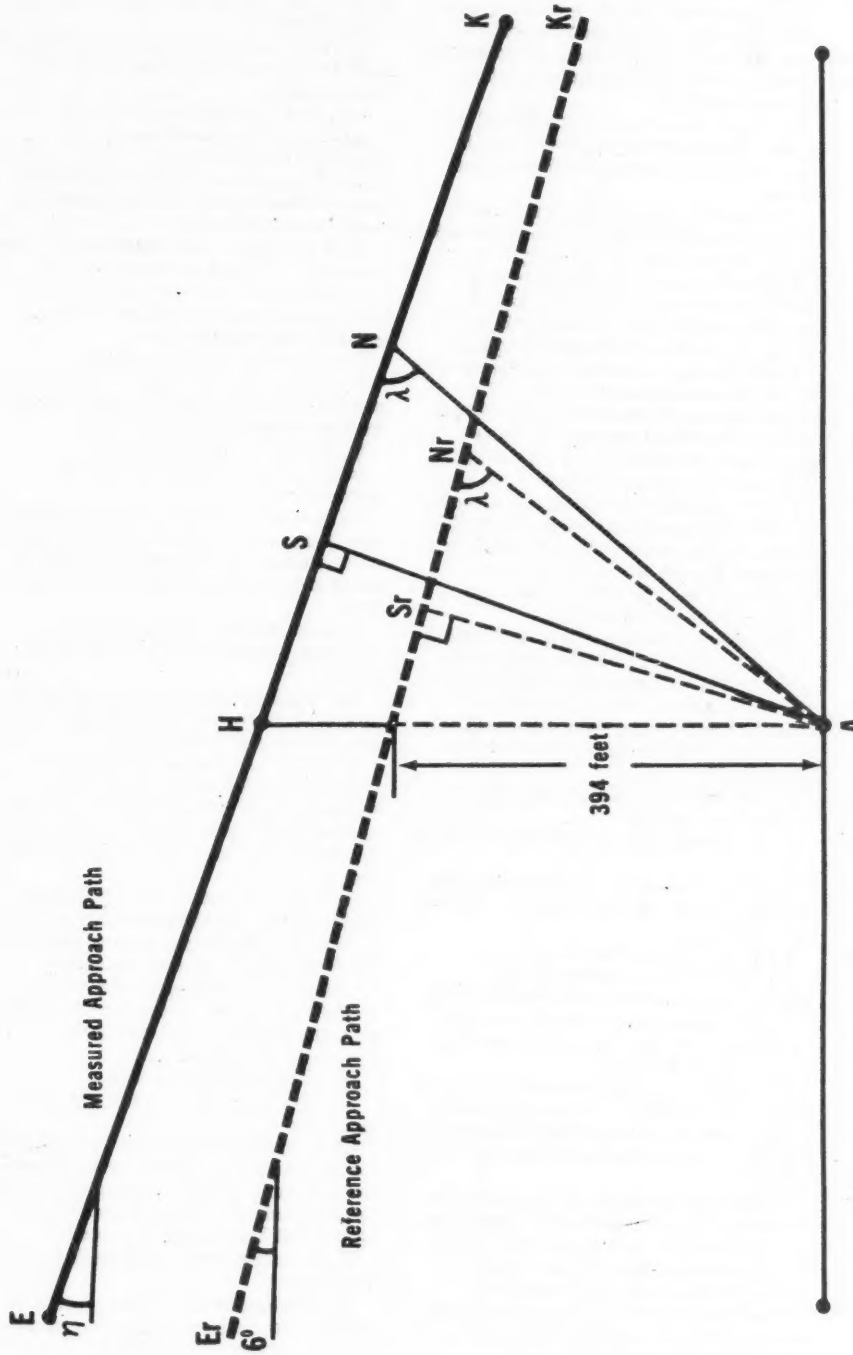

Figure H8. APPROACH PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

BILLING CODE 4910-13-C

PART C—HELICOPTER NOISE EVALUATION AND CALCULATION UNDER § 36.803

§ H36.201 *Evaluation of measured noise values.*

(a) Except as provided in paragraph (b) of this section, the procedures in Appendix B of Part 36 must be used for helicopter noise certification tests under this appendix to determine the noise evaluation quantity designated as Effective Perceived Noise Level, EPNL, in units of perceived noise decibels, EPNdB, for noise level values under § 36.803 of Part 36. Appendix B includes requirements governing determination of noise values, including calculations of—

(1) Instantaneous perceived noise levels;

(2) Corrections for spectral irregularities;

(3) Tone corrections;

(4) Duration corrections;

(5) Effective perceived noise levels; and

(6) Mathematical formulation of noy tables.

(b) Notwithstanding the provisions of § B36.5(m) to the contrary, for helicopter noise certification, tones resulting from ground-plane deflections may not be excluded from the calculation of corrections for spectral irregularities. Each tone correction value must be included in the computation for spectral irregularities. The SPL values must be included in the noy calculation prescribed in § B36.13 of Appendix B of Part 36. [For the alternative to this proposal, see the preamble discussion under § VII G. "Noise Measurements and Evaluation."]

§ H36.203 *Calculation of noise levels.*

(a) To demonstrate compliance with the noise level provisions of § H36.305, three separate noise levels, one for each noise test series, must be calculated from the evaluated EPNdB values in accordance with paragraph (b) of this section.

(b) The calculated noise level for each noise test series (takeoff, flyover, and approach) must be the numerical average of at least six separate EPNdB values of the noise levels measured simultaneously at each of the flight-track and two sideline noise measuring stations. The 90 percent confidence limit for all valid test runs under § H36.105(b)(2) of this appendix applies separately to the EPNdB values for each noise test series.

PART D—NOISE LIMITS UNDER § 36.807

§ H36.301 *Noise measurement, evaluation, and calculation.* Compliance with this part of this appendix must be shown with noise levels measured, evaluated, and calculated as prescribed under Parts B and C of this appendix.

§ H36.303 *Noise measuring points.* Compliance with the noise level standards under § H36.305 must be shown for each takeoff, flyover, and approach test series at noise measuring stations located at the following points:

(a) *Flight-track noise measuring point*—On the centerline of the flight track projected vertically below the reference flight path; and

(b) *Sideline noise measuring points*—On each side of the flight-track noise measuring point and located 492 feet from, and on a line perpendicular to, the centerline of the reference flight track.

§ H36.305 *Noise levels.*

(a) *Limits.* For compliance with this appendix, it must be shown by flight test that the calculated noise levels of the helicopter, at the measuring points described in § H36.301 of this appendix, do not exceed the following (with appropriate interpolation between weights):

(1) *Stage 1* noise limits for acoustical changes for helicopters are those Stage 1 noise levels prescribed under § 36.11(b) of Part 36.

(2) *Stage 2* noise limits are as follows:

(i) *For takeoff calculated noise levels*—106 EPNdB for maximum takeoff weights of 176,370 pounds or more, reduced by 3.01 EPNdB per halving of the 176,370-pound maximum weight down to 86 EPNdB for maximum weights of 1,764 pounds or less.

(ii) *For flyover calculated noise levels*—105 EPNdB for maximum weights of 176,370 pounds or more, reduced by 3.01 EPNdB per halving of the 176,370-pound maximum weight down to 85 EPNdB for maximum weights of 1,764 pounds or less.

(iii) *For approach calculated noise levels*—107 EPNdB for maximum weights of 176,370 pounds or more, reduced by 3.01 EPNdB per halving of the 176, 370-pound maximum weight down to 87 EPNdB for maximum weight of 1,764 pounds or less.

(b) *Tradeoffs.* Except to the extent limited under § 36.11(b) of Part 36, the noise limits prescribed in paragraph (a) of this section may be exceeded by one or two of the takeoff, flyover, or approach calculated noise levels determined under § H36.203 of this appendix, if—

(1) The sum of the exceedances is not greater than 3 EPNdB;

(2) No exceedance is greater than 2 EPNdB; and

(3) The exceedances are completely offset by reductions in the other required calculated noise levels.

§ H36.307 *Takeoff test conditions.*

(a) This section, in addition to the applicable requirements of § H36.101 of this appendix, applies to all takeoff noise tests conducted under this appendix in showing compliance with Part 36.

(b) A test series must consist of at least six flights over the flight-track noise measuring station (with simultaneous measurements at the three noise measuring stations) as follows:

(1) An airspeed of either $V_y \pm 3$ (knots) or the maximum speed of the curve contiguous to the ordinate of the limiting height-speed enveloped plus 3.0 knots (±3.0 knots), whichever speed is greater, must be established during the horizontal portion of each test flight and maintained during the remainder of the test flight.

(2) The horizontal portion of each test flight must be conducted at an altitude of 65.6 feet (20 meters) above the ground level at the flight-track noise measuring station.

(3) Upon reaching a point 1,650 feet (500 meters) from the noise measuring station, the helicopter must climb constantly at takeoff power (as demonstrated under the airworthiness regulations constituting the type certification basis of the aircraft).

(4) The rotor speed must be stabilized at the maximum normal operating speed (RPM) during the entire period of the test flight when the measured helicopter noise level is within 10 dB of PNLTM.

(5) The helicopter must pass over the flight-track noise measuring station within ±5° from the zenith.

§ H36.309 *Flyover test conditions.*

(a) This section, in addition to the applicable requirements of § H36.101 of this appendix, applies to all flyover noise tests conducted under this appendix in showing compliance with Part 36.

(b) A test series must consist of at least six flights (three in each direction) over the flight-track noise measuring station (with simultaneous measurements at the three noise measuring stations)—

(1) In flight level to the surface;

(2) At a height of 492 feet±30 feet (150±9 meters) above the ground level at the flight-track noise measuring station; and

(3) Within ±5° from the zenith.

(c) Each flyover noise test must be conducted—

(1) At not less than 90 percent of either the maximum speed in level flight with maximum continuous power (V_H), or the certificated never-exceed speed (V_{NE}), whichever speed is less;

(2) A rotor speed stabilized at the maximum normal operating rotor speed (rpm); and

(3) With the power stabilized during the period when the measured helicopter noise level is within 10 dB of PNLTM.

§ H36.311 *Approach test conditions.*

(a) This section, in addition to the requirements of § H36.101 of this appendix, applies to all approach tests conducted under this appendix in showing compliance with Part 36.

(b) A test series must consist of at least six flights over the flight-track noise measuring station (with simultaneous measurements at the three noise measuring stations)—

(1) On an approach slope of 6°±0.5°;

(2) At a height of 394±30 feet above the ground level at the flight-track noise measuring station; and

(3) Within ±5° of the zenith.

(c) Each approach noise test must be conducted—

(1) At an airspeed of either $V_y \pm 3$ (knots) or the maximum speed of the curve contiguous to the ordinate of the operating limiting height-speed envelop plus 3 knots (±3.0 knots), whichever speed is greater;

(3) At maximum normal operating rotor speed; and

(4) With the power stabilized during the period when the measured helicopter noise level is within 10 dB of PNLTM.

(Secs. 313(a), 601(a), 603, and 611(b), Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421(a), 1423, and 1431(b)); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*); Executive Order 11514, March 5, 1970, and 14 CFR 11.45).

Note.—The FAA has determined that this document involves a proposed regulation which is not significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the draft regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified above under the caption "For Further Information Contact:".

Issued in Washington, D.C., on July 9, 1979.

J. E. Densmore,

Acting Director of Environment and Energy.

[FR Doc. 79-21807 Filed 7-18-79; 8:45 am]

BILLING CODE 4910-13-M